THE EXPERT HOUSE PAINTER

SECOND EDITION

(Revised and Entirely Rewritten)

A Reliable Guide for the Experienced House Painter and Manual of Instruction for the Less Expert Workman, Containing Full Instructions for Doing Every Description of Painting Done by House Painters, Together with Valuable and Interesting Information Relating to the Nature and Sources of the Liquids and Pigments Used in the Painting Trade.

Formulas Given for Various Paint Mixtures, Tests for Ascertaining Purity and Value of Materials, How to Choose and Combine Proper Colors in Their True Scientific Relations, etc.

BY

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PHILADELPHIA
DAVID McKAY COMPANY, Publishers
604–608 South Washington Square

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PAINTING ON WOOD

Interior Painting.—Interior painting includes plain work in oil, turpentine, turpentine and oil, and enamel paint. Oil paint is employed only when the color is dark enough to render it immune against discoloration from the darkening of the oil. Turpentine paint is used when a flat or lusterless job is desired. Sometimes a finish having some luster is desired, the effect being known as egg-shell gloss. This is produced by mixing the paint with both turpentine and oil, in certain proportions.

Dead Flat Work.—Usually flat work is done with white lead or zinc white, both ground in oil, thinned out with a mixture of equal parts of turpentine and raw linseed oil, for next to the last coat, the latter containing either no more oil than is in the white lead, or with even that small amount extracted. Extracting this oil is done by mixing some white lead, ground in oil, with benzine, then when the mixture has had time to settle the benzine, carrying with it part of the oil of the lead, is drawn off, and the process repeated until all the oil has been drawn off; then the lead may be thinned with turpentine to the right consistency for application, and driers added, as required; it is best to use very light japan driers or some other form of drier that will not discolor the white; this subject will be treated elsewhere. What has been said concerning drawing oil from lead applies also to zinc white.

Interior Oil Color Work.—There is very little difference in the preparing and using of interior and exterior oil paint, though interior work should have a paint that will dry with a harder surface than is required for outside use. The addition of some turpentine will do this, only being careful not to add enough to injure the gloss of the finish.

Egg-Shell Gloss Work.—Where a full gloss or dead flat finish is not desirable, on account of the glare of the one and the lifeless effect of the other, an egg-shell gloss answers well. It has the combined appearance of both the dead and gloss methods. Taking keg lead, which means white lead ground in oil and used as taken from the keg, and thinning it out with equal parts of oil and turpentine, this semi-gloss will result, and by the use of more or less of either liquid the result will be either more or less of the two effects. But in general, equal parts of the liquids will give a satisfactory egg-shell gloss.

Mixing the Paint.—In all cases when lead is taken from the keg for mixing it should first be worked some with the paddle to form it into a pasty mass, for this will greatly facilitate the final mixing. If an oil paint is desired, then the oil should be added gradually and be stirred with the lead with the paint paddle, until a mixture of the proper consistency has been obtained. To dump a quantity of oil into the pot of lead and mix it means poor mixing, a paint full of lumps. If coloring is to be added, add it before the mass becomes too thin; some colors, such, for instance, as lampblack, or any pigment having a light body, are difficult to mix with lead when it has been thinned down too much. It is also well to stir in the driers while the mass is rather thick, or before the final thinning. But if the paint is not to be used the day it is mixed do not add the driers until you are ready to apply the paint.

Paint in oil, particularly for outside use, gives better results as to wear when mixed a day or so before application, for it allows the mass to become more homogeneous, the slight oxidation also benefiting it, both as to durability and appearance, for what may be called raw or fresh mixed paint will not give that smooth appearance on the finish that the older mixed paint will.

Paint mixed with turpentine should be mixed only when about to be used, though if mixed and kept in a perfectly sealed can age will not affect it. Like oil paint, the thinners should be added a little at a time, and be well stirred in, the driers being added before the mass becomes too thin. And the same procedure is indicated for the egg-shell gloss paint.

All paints of whatever composition should be well strained before using, or immediately after the mixing. This not only removes all specks, lumps, etc., but it removes any possible unmixed color and improves the mix very much; such paint can be applied more rapidly than unstrained paint, and the finish will be smoother. There are brass wire gauze strainers for the purpose, fitting over the paint pot, and for large batches these are to be chosen; but for, say, a potful mix a piece of cheesecloth, or small salt bag, makes a fine strainer, finer than wire gauze. Lay the cloth over the pot and fasten it around the sides of the pot, at the wire rim, with common string or light twine. Before pouring in the paint that is to be strained push the center of the cloth down a little with the sash tool that you will use to rub the paint through the cloth. Have a tin cup handy for putting the strainings in from time to time. When all the paint has been put through the strainer untie the string, hang it up for future use, and remove cloth from pot by taking hold of its edge until you have it in hand as a small pouch, when it should be laid in water to keep it for another time. Brass sieves should be cleaned when done with, being first brushed out and then cleaned with a cloth dampened with kerosene or benzine; and, when all the mesh has been freed of paint, hung up. It pays to keep all shop appliances clean and in place.

In mixing paint for inside use it had better be rather stout than thin, though this does not imply that it must be applied so as to leave a heavy coat; this heavy paint should be rubbed out well. As the requirements of surfaces indicate, we must mix and apply the paint to meet conditions. This matter will be fully treated in describing the painting of various woods and surfaces.

First or Priming Coat Inside.—If the woodwork is white pine the priming should be made of white lead thinned with raw oil, adding a little japan driers. This coat must be quite thin, consisting of the oil whitened with the lead. It should be well rubbed into the wood and a smooth surface be secured. If there are any dark or sappy places or knots, these must be treated. Knots should be coated with thin white shellac varnish, which is also good for sappy places. For dark spotted wood, or wood not uniformly white, it will be best to add a little black to the priming, which will give a uniform coating, hiding the dark places. Use little driers in primer.

The second coat should be composed of white lead and oil with the addition of a little turpentine and driers. This coat may be made somewhat heavier than the priming coat, but not to say heavy. It too should be well rubbed in and laid off uniform and even. Remember, that the smoother you get the work at the beginning and through the next coat the easier it will be the rest of the way.

The third coat, where an oil finish is desired, will be the last; hence it should be made rather stout, with oil and maybe a drop of turpentine, with also driers, and be applied with a full brush, laying it off evenly and smoothly.

If the finish is to be flat, four coats will be better than three, though this will, of course, depend upon the grade of work. In the very highest grade of interior white flat work as many as a dozen coats have been employed, or even more. But where there are only four coats let the third coat be a solid one, made up of equal parts of oil and turpentine; to secure a perfect flat effect the under coat must be rather inclined to a luster, though not fully so. This matter will be treated fully under another head.

SANDPAPERING, PUTTYING, ETC.—It is important to allow proper time for each coat of paint to become quite dry, before applying the next. The priming coat should be sandpapered with a medium coarse paper, say No. 1, to secure a smooth surface, after which it should be dusted off. The same with the next coat. Putty work is done on the first coat, filling all nail holes and other depressions or defects requiring it, smoothing the putty over to a level with the general surface and so insuring a uniformly smooth surface for the next coat. The putty should be well pressed into the cavities with the ball of the thumb, passing the putty knife under the thumb and so effecting a neat fill. This method enables one to fill nail holes very rapidly, after some experience. For ordinary work the common oil and whiting putty does, but for some kinds of work this will not do; all of which will be related in detail further on. A white finish requires a white putty, and this can only be made from white lead, from the keg, mixed stiff with whiting. It is simply impossible to hide common putty with a coat of white paint, or even with two coats, in some cases.

When sandpapering, the resultant dust may be prevented from filling the air and lungs by wetting the sandpaper with turpentine, and a cloth or paper should be laid down where possible to catch the dust as it falls and where the paper or other abrasive material has not been moistened. The cloth or paper may then be shaken outdoors.

In the application of interior paint the grade and condition of the brush is important; it is unfortunately rather difficult now to buy high-grade brushes, owing to the difficulty of securing the best bristles abroad; those from the Chicago stock yards are somewhat inferior to the best Russian bristles, but buy the best possible, and it will be economy in the long run. For priming work a new brush does not do, one that has been worn down a little answering better. Nor does a new brush produce as smooth a job as one that has been worn into a good shape, chiseled, and square of point. It is a good idea to use the new brush on some common work first, to get it worn down properly. The shape and size of the brush is important too; for interior work a full round or oval brush is best, the wide or wall brush being better adapted for wall or common painting. As to the size of the brush, while some prefer an 8-0, many use the next larger size, the 10-0. Either will do good work, and the size of the surface should determine which brush will do the work best. The smaller brush will be more effective on small areas or surfaces than the larger one. This is a rule with vehicle painters. With a set of brushes for the house painter we include the 8-0 or 10-0 round or oval brush, the No. 8 or No. 10 sash tool, and a small one called the fitch, which is a bristle brush, a very small one that is useful in getting into very small places. There is also the duster and putty knife to finish out the painter's kit.

Number of Coats Necessary.—Usually three-coat work is the rule, but this is only for the average and ordinary grade of painting. While very good work may be done with three coats, this will depend upon the character and amount of paint applied, together with the manner of application. Specifications fix the number of coats to be given, the character of the paint, and manner of its application; it must be done in a "workmanlike manner." Something also depends upon the kind of wood that is to be painted. If white pine is to be done then the three coats will prove enough. But on such a wood as cedar or cypress and some other woods much used in building construction now, three coats will, in some cases at least, prove too few to hide the wood and give a uniformly good finish. And it is certain that less than two coats, even of the best paint, applied correctly, will not give a good finish.

Manner of Application.—In applying paint to woodwork there is a wrong and a right way. It requires some practice to enable one to apply paint properly. The beginner or amateur dabs it on and rubs it out in short jerky movements of his brush. The result is seen in a rough and very uneven surface. The expert takes his full brush and applies two or three preliminary strokes, to distribute the paint over the area he is about to cover, then proceeds to rub it out evenly by longer movements of his paint brush. After covering the surface, having run his brush in up and down motions, he then crosses the work, brushing it at right angles with the first brushing. In this manner he secures an even spread of the paint and gets a smooth and uniform surface and finish.

Taking a Brush Full of Paint from the Pot.—In the first place let it be said that the paint pot must be clean at the start, if clean work is expected. Usually the paint pot is placed at the feet of the painter, unless he is either working on a scaffold or from a step ladder. It would seem that if the pot were to be placed nearer to hand it would save stooping and time too. But usually the pot stands on the floor, and each dip of the brush means a bend double of the workman, and more or less danger that some of the paint will fall from the brush on its way. When an amateur dips in his brush it is simply to secure a portion of the mixture on the tip of his brush, and this he lifts by tilting the brush at right angles and bringing it up to the work. In this way he is bound to drop paint on the floor. The expert does it differently; he dips in his brush with more confidence, gets more on the brush, and before lifting it out gives it a few flaps against the insides of the pot; this equalizes the paint on the brush, and removes surplus; then he carefully raises the brush, handle down, to the work.

Formula for Flat Finish Work.—This was briefly described in the beginning of this section, but details are herewith given: The priming coat is made from white lead thinned with two-thirds raw oil and one-third turpentine, adding a little good japan drier. When dry, sandpaper with No. 1 paper or equivalent abrasive material, and stop all nail holes, etc., using white lead putty. Second coat with white lead thinned with equal parts of oil and turpentine. When dry, sandpaper as before and dust off. The sandpaper used on this coat is No. 2. The third coat is composed of white lead thinned with turpentine, and adding a little white japan driers. As before, the work is sandpapered and dusted off. The fourth coat consists of French process zinc white, thinned with turpentine; it should be stated here that the zinc is that which comes ground in oil. Add a little white japan driers. Again sandpaper and dust off. The fifth and last coat is made from French process zinc white ground in white or pale damar varnish, thinned with turpentine, and with a little white japan driers. The whitest gum damar varnish is that made from the Batavia gum, the other sort being rather yellowish.

The formula given is that in use by some of our most expert painters, and it certainly requires an expert, even a genius, to do a fine piece of such work as dead flat finish. As flat paint sets and dries quickly the workman has to be lively in order to avoid laps or brush marks.

Drawn Flatting.—This method of drawing the oil from white lead that has been ground in oil has been described. It is a very simple and good way, but is not the only method employed in order to secure a perfect flat finish. The modern way is to grind the dry white lead in a mixture of oil, turpentine, and japan, adding just enough flatting varnish to cause the paint to flow out and level up nicely. This method can be used for the production of all colcrs, as well as for white flat.

ENAMEL PAINTING

An expert master painter says he never bids on a first-class job of enamel painting that calls for less than eleven coats. But most painters will not be called upon to do such very fine work as this. Here is a formula for doing an 8-coat job. Make the foundation smooth and perfect. Prime with white lead containing a little yellow ocher; reduce to working consistency with 1/3 raw oil and 2/3 turpentine; add a little japan driers. When dry enough sandpaper smooth and dust off. Second-coat with rough-stuff to level up. When dry, sandpaper and rub down to a smooth, even surface. Third-coat with white lead thinned with 3 parts turpentine and 1 part boiled oil. Fourth coat, white lead thinned with 5/6 turpentine and 1/6 white varnish. Fifth coat, equal parts of white lead and Green Seal French zinc white, thinned with ¾ turpentine and ¼ white enamel varnish. Seventh coat, all Green Seal French zinc white mixed with ¾ white enamel varnish and ¼ turpentine. Eighth coat, white enamel varnish colored with the zinc white and enough turpentine to make the varnish flow smoothly. Sandpaper each coat but the last, using very fine sandpaper or hair cloth. The first four coats should stand not less than three days each, and the last four coats not less than six days each. Finish by rubbing with fine pumicestone powder and water to a dull finish. If a high polish is desired follow this by rubbing with powdered rottenstone and sweet oil. If the wood is of a sappy nature follow the priming coat with a very thin coat of white shellac varnish.

The last coat is sometimes finishing varnish, left in the gloss, or polished to a velvet or satin finish, as desired. Some painters shellac the bare wood, and prime over it.

Another expert painter sends us the following as his method: Prime with white lead thinned with one part turpentine and three parts raw oil; the following three coats are made from drawn zinc white, drawing the oil until practically all has been extracted. Mix this with damar varnish. If the finish is to be some tint or color, make the first zinc coating several shades darker than the finish is to be, then making each successive coat a trifle lighter in shade than the first. The fifth coat is made a color-and-varnish mixture; that is, enough of the colored paint is added to the varnish to discolor it. But if the finish is to be white, then use zinc white thinned with the best white copal varnish, the kind that is specially made for the purpose. If tinted work is required, then tint the zinc-white before adding the varnish. The sixth coat is this varnish-color paint, and when dry it is ready for rubbing with powdered pumicestone and water, followed with rubbing with powdered rottenstone and water. This will produce an egg-shell gloss. Further rubbing, with rottenstone and sweet oil, will impart a polish. This method gives a very pleasing and durable enamel finish.

Enamel Finish on Cypress.—Owing to the gummy nature of this wood the surface must be glue sized, applied hot. The priming coat over this is made from white lead thinned with a mixture of raw oil three parts and turpentine one part. Add also a little japan drier. Often this wood is quite dark, in which case add a little lampblack to the primer. After the priming coat proceed as directed for enamel work in general. When a dead finish is desired it is usual to apply the glue size to the bare wood, but when to be a gloss finish the glue size is applied over the priming coat. In the latter case the size should be made from white glue, to which add a little dry zinc white; make it rather heavy, and apply hot; when dry, smooth up with fine sandpaper. Subsequent coats may be as for white pine.

Notes on Enamels and Enamel Painting

A distinction must be made between the true enamels and what are known as varnish colors. Usually, true enamels are made by grinding a pigment in an enamel varnish, reducing this to a consistency fit for the brush with more varnish, and maybe with a small amount of turpentine. Any brand of pure zinc oxide may be used, if its color is right, but for the best white finish the Green Seal French zinc white is preferred.

Tinted enamels are made by adding some color to the white zinc, these colors being ground in equal parts of bleached linseed oil and white grinding japan.

The varnishes most suitable for enamels are damar and pale or so-called white copal; the former for special white enamels, the latter for hard, tough enamels. Batavia gum damar gives the palest of the damars; some cheap grades of enamel varnish are adulterated with "Water White" rosin. Zinc sulphate or zinc resinate is sometimes added to harden the damar, and as this usually produces a cloudiness in the varnish a trifle of grain alcohol is added to remove it.

White enamel paint containing any linseed oil or colored resin will in time turn yellow in the absence of plenty of sunlight. Enamels intended for refrigerators, closets, and all closed places must be made from the palest and best Batavia gum damar.

In the preparation of damar varnish the gum is first made hard by a certain treatment, then it is dissolved in pure turpentine spirits, in the ratio of from 6 to 10 lbs. of gum to the gallon of turpentine. The turpentine employed is the best, that distilled from the pure gum from the tree. Wood or stump turpentine will not do, as it would cause the enamel to turn yellow in the dark. But cheap white and tinted enamels contain wood turpentine, the strong odor of which must be masked with an essential oil, such as mirbane, etc. Acetone, benzol and benzine are occasionally used in enamels, either as a thinner or as a solvent, but, unlike wood turpentine and rosin spirit, these impart no color.

The factory prepared enamel paint will usually have to be thinned out in order to cause it to flow out and level up well. Turpentine is the best thinner for this purpose, as regards its power to cause good flowing, but its equally good flatting quality renders its use for this purpose undesirable, unless it be mixed with an equal quantity of benzine. Benzine has no flatting quality, but it is very difficult to dissolve either damar or copal gum in this fluid, hence its addition to the enamel must be very sparing. And when thinning any varnish containing little oil, such as enamel paint, or varnish, damar or copal varnish, with benzine, add it very slowly and stir continually until perfect mixture takes place.

Refrigerator enamel is made from hardened damar, contains no oil or colored rosin, makes the most lustrous of all enamels, and will not turn yellow in the dark, is extremely hard, not very elastic, needs a non-absorbent primer for the foundation coat, and so becomes the most desirable enamel for the interiors of refrigerators, closets, cabinets, deposit boxes, etc. Better results are obtained by baking four to six hours at 180 degrees Fahr., this giving an extremely hard and tough enamel coating.

Polishing enamel differs from refrigerator enamel in containing white copal and some refined linseed oil; this enamel is usually quick-drying, and must harden in from 24 to 48 hours, so as to allow of sandpapering or rubbing down with pumice powder. An extra fine job may be obtained by giving the work a coat of some non-absorbent primer, two coats of polishing enamel, sandpapering or rubbing with pumicestone powder, and finishing with a coat of enamel paint. For exterior work finish with marine enamel.

Marine enamel, as its name will indicate, is made to withstand water, hence is designed for bath tubs, sinks, water pails, and any place or thing that has more or less of moisture to meet. Neither hot nor cold water affects it; if baked, this enamel will withstand submersion in salt or fresh waters for months without becoming soft or otherwise affected. Such enamel has to be made from the best of high-grade varnish, and must not contain any resin (though some brands do, just a little).

Exterior enamel is designed for all work exposed to the weather. It is made from a slow drying, pale finishing varnish, and will not do inside, its main purpose being for store fronts, camp furniture, etc.

Satin-finish enamel dries to a satin-like surface, resembling polished ivory; in time it becomes as hard as ivory, and may be employed on either interior or exterior work.

Low priced enamels are made from cheap materials, such as rosin oil or rosin varnish; they work well under the brush, level out right, are lustrous, but not durable. Somewhat better low priced enamels are made by adding just enough hard gum with the product to prevent it from easily powdering on the surface, as the cheap enamels usually do.

The thinners supplied by manufacturers of enamels consist of turpentine, benzine, toluol and benzol, with just enough damar or white copal varnish to prevent flatting. The thinners for a flexible enamel differ by containing a linoleate instead of varnish. The flatting of an enamel is caused either by a poor foundation or by excess of thinners.

Enamel Painting Footnotes

Some workmen rub enamel paint to a polish with crude oil and the abrasive substance, but this oil is very apt to soften the varnish and soil the work, requiring removal of the surface and re-doing.

To get a good job over old paint it is safest to remove the latter to the wood. Of course, where the under coating of paint is good and presents a solid surface the removing need go no farther.

Freshly made enamel paint usually works thin under the brush, shows brush marks, and does not flow out well. Hence it is best to allow the paint to have a few days' age before using. But do not let it get too old, for in that case it is apt to be ropy. In this case try immersing the can of paint in warm water before using. If it has to be thinned, then thin it with the mixing varnish that the maker provides for the purpose.

The less oil in the coats of paint under the enamel paint the less the danger of yellowing the finish.

Owing to the varnish in it, enamel paint usually works rather hard under the brush. Quick drying enamel paint works hard and does not wear well; it is impossible to produce a quick drying enamel that will prove durable.

A quick drying enamel paint should have pigments ground in turpentine and thinned with gold size; such may safely be used after the priming coat on new wood, or for all coats on metal. But for old painted work such an enamel paint is apt to crack; in this case an egg-shell enamel will be best.

An enamel paint that is to stand weather exposure must be a quick drier, give a hard surface, yet be elastic enough to contract and expand with the weather without cracking. The enameled surface must be quite smooth and glossy. Exterior enamel paints dry somewhat slower than interior enamels, since a more oily varnish is used in order to make it more elastic, and here is where the trouble comes in making the right enamel; it must be elastic yet not too oily, for in the latter case it would remain soft. The other extreme will cause the enamel to crack and to leave the surface it is applied to.

The addition of a tablespoonful of coal oil to the gallon of enamel paint is said to make it work easier under the brush, without injuring its luster.

Or thin out with benzine, which will allow of easy spreading and not injure the gloss, as the benzine evaporates and leaves a thin coating of the original enamel. This method avoids laps in the paint, too.

Camphorated turpentine, made by dissolving two ounces of gum camphor in one gallon of turpentine, is an improver, as given in the following formula:

Formula for White Enamel

Florence zinc white	5 lbs.
White damar varnish	1 gal.
Thin with	
White enamel varnish	1 gal.
Camphorated turpentine	1 pint.

Where an elastic, slow drying, durable primer is used plenty of time must be given for it to dry before applying the next coat. As a rule each coat, from the priming up, should be a little harder than the succeeding coat, in order to effect the contraction due to drying, and it is essential that the coat of paint next to the enamel be of a non-absorbent nature, otherwise the final coat of enamel will not have the necessary "fullness" and luster.

Non-absorbent primers and second-coat paints are made by combining a little varnish and a very small quantity of driers with the oil; oil alone requires months of drying before it becomes non-absorbent.

PAINTING HARD-FINISHED WALLS

By hard-finished is meant walls of rooms coated with lime and sand plaster. Such walls are rarely hard, strictly speaking, and in workmanship range from poor to bad. In olden times room walls were really hard, and in some cases difficult of penetration by a nail driven by a hammer. What were called wash-walls were especially hard, more like marble, the result of having been rubbed down with water and trowel for quite a while. These were called wash-walls because the housewife washed them clean now and then, maybe once a year, neither paint nor paper being permitted to desecrate the excellent surface. To-day we have soft walls, many composed of little plaster of Paris and plenty of lime putty, and this in thin coats. Such walls are not fit to paint or paper on. But we have them and are asked to paint them, sometimes with water color, other times with oil paint.

The suction of these plaster walls is very great, and how to stop it is a subject full of difficulties. Master painters do not agree upon any one method of sizing the walls. Some argue for one thing, others for another thing. Weak glue size has for years been a common size. But many object to it on account of its not being proof against moisture, an element very common where lime is. Varnish thinned with benzine is a favorite size. The first thing to do, however, is to kill the lime. An acid will do this, vinegar, for example. A chemist advises an acid size made by adding a gill of muriatic (hydrochloric) acid to a pail of water. This acid unites with the free lime and forms hydrochloric acid gas; this evaporates, leaving on the surface of the plaster sodium hydrogen sulphate, which is then easily removed with clear water.

Another way to size the walls is to first apply a hot, thin glue size, and when dry apply a thin coat of lead paint. This prevents any possible dampness getting under the paint, for the glue and first coat unite in filling the pores of the plaster and form a hard surface. I have never known dampness to hurt a job done this way. Still another method, favored by many, is to first apply a thin lead coat, and on this apply the glue size. Many ask, why the glue size at all? Because it fills better than a lead primer will. It is cheaper and more rapidly applied. It dries quickly and leaves the walls ready for paint in a few hours, while lead paint could not be made to dry in less than 24 hours, fit to work on.

Should the wall have some porosity, in order to hold the paint well, is another disputed question. A noted British decorator contends that the wall should have absolutely no porosity, while an equally expert American painter takes the opposite view. Doctors will disagree. It must be remembered that plaster walls are not things like enameled marble, they have a surface more like wood, and hence are in no more need of porosity than wood in order to hold paint.

It is useful to listen to the experts when they give their views upon these matters. One tells us that if he were allowed to have his own way and make a perfect job of wall painting he would first have the walls well glue sized, then glued, and on this he would put muslin or light canvas, allowing time for all dampness to dry out. He would apply a coat of thin white lead and oil paint, with some driers. This would be followed by a coat of lead and oil, with about one-third turpentine too. Then another coat like it. Then the fourth and final coat, white lead thinned with turpentine only, with a proper amount of driers. This latter coat should be stippled in order to secure an even, uniform surface. Stippling of the third coat would be well, as it would do away with all brush marks and help in the finish coat. If a pure white job is desired use zinc white in place of white lead for the last coat.

The covering with muslin is always advised where the wall is broken or where a first-class job of plastering has not been attempted. It prevents any cracks, large or small, appearing under it.

"Examine the plaster, clean it off and repair any breaks. Apply a thin coat of paint, oil paint thinned with plenty of turpentine; let it stand two days, then any fire cracks will show up. Apply a coat of glue size and let the job stand until the next day; apply then a coat of paint made from white lead, thinned with oil and turpentine, with driers. Stipple lightly, and let it stand 24 hours; then apply another coat, any kind of finish desired, such as semi-gloss, egg-shell gloss, or flat finish.

"On some walls a priming composed of equal parts of red lead and white lead, thinned with boiled oil and made quite thin, does best, as it enters the pores of the plaster and makes a firm foundation for the finish.

"For the better class of wall painting we have found that a size made up of equal parts of benzine, furniture varnish and dry pigment, lead or whiting, all by measure, gives satisfactory results. It makes a solid foundation, saving paint.

"It is a practice in many parts of the country to glue size a raw plaster wall before painting, but nothing could be worse. The glue will prevent the oil from sinking into the wall and anchoring there. Feed the plaster with oil until it will absorb no more.

"Varnish, hard oil, liquid filler, etc., have been favored where plastered walls are to be painted. These stop suction, dry quick, then a coat or two of paint; yet they cannot be recommended on good work for the reason that they dry too fast, do not contain enough oil to penetrate the plaster; in some cases they cause peeling and cracking. Such sizes dry very quickly on hot days, the liquids evaporating and leaving a brittle coating.

"Water glass is perfectly safe to use on new plastered walls as a size, because it forms with the caustic lime an insoluble silicate of lime, which is inactive because insoluble. Water glass, the silicate of soda of commerce, should be diluted one-half with water; apply with a fiber brush. If the plaster is rather hard and smooth, a still weaker solution will do. This size answers equally well under water and oil paints.

"Whether there is a chemical action or reaction, strictly speaking, when soap, glue and alum are mixed together, we are not prepared to say; but it is a fact that a mixture of soap and glue alone will not harden sufficiently to be painted over. The addition of alum hardens the soap to a certain extent, and renders the glue insoluble on exposure to the air. When glue size without soap is used, the addition of alum keeps it from souring or molding; and when a size of soap without glue is used under water paint, it is liable to rub up unless alum has been added to the soap solution. With oil paint this would be different."

A good vinegar size may be made from one-half pint of strong vinegar to the pail of water. It neutralizes the free lime. Let it become perfectly dry before applying paint.

WALL PAINTING NOTES

Cleaning Walls.—Painted walls in good condition, with the exception that they are dirty, may be made clean in the following manner. It is well to have two men on the job, to avoid spotting or streaking. A stretch of three or four feet is as much as should be done at a time. First dampen the wall with a sponge saturated with water; follow this with soap suds made from white soap and water; apply with a calcimine brush, scrubbing the surface a little with the brush. This will soften up the dirt. Next make up a compound consisting of 1 lb. of white soap, shaved, placed in hot water, ½ gal.; then stir in 2 lbs. of whiting; allow this to cool. Dip a brush into this mass and scrub the wall gently, just enough to soften the dirt; sponge off at once, with clean soft water and wipe down with a chamois that has just been wrung out of water. Take care that not too much water is used on the work; sponge and chamois should be wrung out as often as possible, the water being frequently changed. Start the work at the bottom and continue up to the ceiling. Clean the ceiling in the same manner.

To clean off a dirty wall before painting apply a coat of uncooked-starch water; when it is dry brush off, and the dirt will come with it.

To clean a greasy wall before painting scrub with strong vinegar. A thin coat of fresh lime water or thin whitewash is good on a smoked wall.

Wall Defects Treated.—Where the plaster is put on an interior brick wall and the latter is more or less damp, the alkali of the lime will come through and cause spotting, these spots in turn coming through size and paint. The only thing then to do is to scrape down to the plaster and perhaps down to the brick-work, and remove the bad spots. Then fill in with plaster of Paris, pressing the plaster well into the hole. Then size and apply a hard lead putty, glazing the place at first, after having sandpapered smooth. When the putty has become hard, sandpaper it. Then give it a priming coat of white lead thinned with 3 parts raw oil and 1 part turpentine, with a little drier. When this is dry apply a coat of glue size, after which give the finishing coats of paint, whether oil or flat. Some claim that saltpeter spots on walls can be removed with kerosene oil, allowing it some time to dry, then apply a coat of flat paint. Then size with glue size, quite thin, following with another coat of flat paint.

Where the walls and ceiling show fine or small cracks, and where also are uneven places, and it is desired to make a first-class job, try this method: Mix dry white lead and coach japan to a stiff paste, and with this go over the cracks and uneven parts, using a broad glazing knife; make the surface smooth and level. When dry, sandpaper it smooth. This plaster will not absorb the paint any more than the rest of the surface will.

Spots on walls plastered directly on the bricks are sometimes due to dirty bricks; they may be old bricks taken from a chimney, or bricks that were directly exposed to the fire of the kiln. The only cure is cutting out the bricks indicated by the brown spots on the wall, and putting in clean bricks. A workman says that he has known a spot to come from a sooty brick clear through a four-inch marble slab, discoloring the marble.

Painting over Calcimine.—If the calcimine coat is in good condition, no trouble will follow its painting with flat or oil paint. But add plenty of turpentine to the first coat of paint to carry the paint into the calcimine and hold it. The calcimine will not need sizing before painting, unless it is in bad condition, in which case use a size made from varnish thinned out with benzine or turpentine. Or use a liquid made from equal parts of raw oil, turpentine and japan driers. Gloss oil is also used.

To Prevent Laps in Flat Oil Painting.—Where a sufficient number of hands are employed for the job, dead flat painting is easily done without danger of laps. But where this is not possible an expert advises the addition of a little varnish in the last coat, one man applying the paint and another man following with the stippler. In this way laps are impossible.

Finishing Plaster Wall in Flat Oil Paint.—The Master Painters' Association adopted the following method for painting a hard-finish wall in flat oil paint. Fill cracks, then sandpaper smooth. Prime with paint made from white lead, 5 lbs. to the gallon of thinners. Let dry and apply a coat of hot glue size, well rubbed in. Mix and apply a paint made from white lead, medium consistency, thinned with equal parts of oil and turpentine. Tint this coat to agree with that of the finishing coat. Next coat, white lead, tinted, and thinned with ¼ oil and ¾ turpentine, tinting a little darker than the finish is to be. Stipple this coat. Now apply the last coat, ¾ zinc white and ¼ white lead; stipple. Lithopone may be used for the last coat, instead of lead and zinc white. While no mention was made of driers, it is presumed that it was used throughout, in the usual manner.

Where an extra finish is sought it is better to apply a coating of whiting calcimine, rather stout, and when dry sandpaper smooth. This is to fill all cracks and irregularities and make a good ground for the finish.

Dead Flat Effect.—A wall that is not uniform and first-class for painting may be done in oil color, when it will show many fine cracks. Paint the wall in oil color, as usual, and when dry apply a coat of cooked starch, which stipple. This will cause the entire surface to have a solid, uniform, dead-flat appearance. Whenever a painted wall is to be preserved from smoke, etc., it is well to treat with the starch as explained. Then when the starch looks dirty it may be washed off and another coat applied.

Another way to treat the wall mentioned as being defective is to add a little beeswax in the last coat of paint, melting it in some of the oil used in thinning the paint. This will give the finish a semi-dead flat effect. Buttermilk, freed from all particles of butter, may be used in place of starch; or skim milk or sweet milk will do.

These treatments are also effective for a wall that shows glossy in spots.

Painting Sandfinished Walls.—The condition of a sandfinished wall is bad at the best for receiving paint, but some are very bad. The first thing to do is to examine the surface for cracks and other defects. Open up cracks and wet them with water, then fill with plaster of Paris and clean sand, mixed to form a plaster. Trowel this down smooth, using plenty of water and a cork trowel, or one made of wood and called a "float." The troweling brings the sand to the surface and gives to the repaired part the appearance of regular sandfinish. If the wall is very rough, first go over it with coarse sandpaper or brick, to remove the roughest parts. After brushing down the wall and repairing all defects, size the wall with a mixture of rosin or gloss oil thinned with benzine or turpentine, with a little plaster of Paris, which will stop suction and fill the pores. If the wall is uneven, rough and full of hollows, apply a coat of strong sized calcimine, and when this is dry give it a coat of white lead paint thinned with oil and turpentine.

There is objection to the use of glue size on this kind of wall, though many do use the glue. It does not give as stable a foundation for the paint coats as lead and oil, of course. But where the price for the work is small it does not pay the painter to size with white lead and oil, but he can use calcimine, made up of whiting and plenty of glue.

After the wall has been properly sized and filled, proceed to finish it with paint as you would on a hard finish wall. The finish may be plain or fancy, white finish, tint or color. The last coat may be dead-flat, gloss, or egg-shell finish. If deep rich colors are desired you can glaze on a proper ground color and have a blended effect, mottled effect, clouded or scumbled, leather, or fabric effect.

FLAT WALL PAINT

THERE has been a diversity of opinion regarding the proper treatment of walls before applying flat wall paint, yet it is generally conceded that the first coating should consist mainly of linseed oil. Most flat wall paint makers put out a thinning vehicle that is mainly linseed oil. The foregoing relates to new walls, or walls that have never been painted. In the case of walls that have been painted there is even more want of unanimity of opinion. This arises from the fact that white lead, as the old paint on the wall is composed of, does not agree with lithopone, the main ingredient in flat wall paint. But the danger has been much exaggerated, and there is no danger from applying lithopone paint over a lead painted surface, if the latter is dry, and vice versa, so far as any reaction between the two pigments is concerned. Some painters have even made exterior paint in which the main pigments were sublimed lead and lithopone, and claim good results. Where the flat lithopone paint has not done well over old flat lead paint we must find some other cause. Possibly the trouble has been due to a poor physical condition of the old dry white lead coating. It is impossible to get much linseed oil in flat lead paint, as excess of oil would mar the flat effect. Such flat coat is deficient in binder when applied, and it grows more brittle with age, from the saponification of the oil by the lead, and possibly through reaction with the lime of the plaster. The same coating applied out of doors would rapidly check off, and would practically have disappeared by the time the surface came up for repainting, but with indoor exposure only it remains on the wall, though none the less perished and dead.

Such a surface is unfit as it stands for supporting a finishing coat properly, whatever may be the pigment in it. It greedily absorbs the vehicle from the new coat, but not equally so over the whole surface, leaving the latter of uneven luster and more or less deficient in binder. The new coat may check, or in some cases may pull the old dead coat off. Two coats of flat finish will be needed in all such cases to get a uniform looking job, and if the first of them is liberally thinned with linseed oil so as to add some life to the undercoat, the job will be the better for it.

It is manifestly impossible for the manufacturer to cover in his directions all the cases that arise in practice, and specify the treatment for each. More depends upon the man who applies the paint than upon the paint itself. It is with a finishing coat of paint as with varnish—it is the last thing which goes on the job—and if the results are unsatisfactory the unthinking man is apt to blame the finishing coat, whatever it may be. The careful painter looks well to his foundation, and this should be the watchword when using modern flat wall finishes.

In securing a satisfactory job with flat wall finishes built up with lithopone, much depends upon the preparation of the wall or surface. Unfortunately, the plaster on walls, especially the sand-finished kind, is not uniform—the hard spots holding up the wall finishes and the porous parts soaking it in. Glue size, while permissible under calcimine, is undesirable as a means of holding up flat wall finish. Either the varnish content of the wall finish, drying hard, causes the glue to curl and peel, or the water, after continued washings, goes through the porous paint coating, softening the glue with disastrous results. Gloss oil should not be used, as it does not resist moisture. A good, free-working varnish size, consisting of a gallon of varnish to which a quart of flat wall paint has been added, will be found thoroughly satisfactory.

Flat wall finishes are all made on the same fundamental formula; the essential pigments are lithopone and zinc oxide with or without inert pigment and with the addition of the ordinary colored pigments in the tints and shades.

As undercoating for enamel they will be found useful, owing to the ease with which they may be sanded. On steel ceilings they will be found to be just as satisfactory as on plaster or fiber board. They produce a very pleasing effect when applied over burlap, the latter being first treated with a coat of a good liquid filler. They may be liberally thinned with turps or benzine and applied to window shades to restore the original color or to change the shade to conform to a new color scheme in the room. For finishing radiators they are excellent, as even the white and light tints show little tendency to change at the temperature of hot water and low pressure steam.

It should be understood that while lithopone can be used very extensively in interior painting, it cannot be used in the same way as carbonate of lead or oxide of zinc, but must be used with more or less discretion and knowledge of its nature, otherwise the painter is apt to get into difficulty. For instance, green or chrome yellow, which the painter uses generally, is made from a lead base which will work with oxide of zinc or carbonate of lead without detriment, but cannot be used with the proper degree of safety in lithopone. In all cases where a green or yellow is to be used it ought to be a chromium oxide or a mixture of zinc yellow and cobalt blue. These particular colors are, of course, lime proof and are superior for interior work or cement work, and should always be used in connection with lithopone.

Merits of Lithopone Wall Paint.—Lithopone is more opaque, it obliterates better than white lead, therefore, for covering up old discolored white or pale tints, it is more effective, and two coats may serve where three of lead might have to be used.

It is whiter than white lead, and retains its whiteness when properly mixed with the correct drier and oil for far longer periods than white lead, and when delicate tints are required it gives purer tones than lead, and these in turn retain their pure tones longer than if made with white lead.

It works as freely as lead, and follows the brush more like lead than oxide of zinc does.

It is lower in initial cost per hundred weight or per gallon than lead, and when the strong points I have enumerated are taken into consideration it must be admitted that it is a desirable article for painting purposes.

The pigment is not brittle, and if any flaking or inelasticity manifests itself, the fault is said to be in the binder. It is more elastic than zinc oxide and is not discolored by sulphurous gases, as is white lead.

The tendency of lithopone paints to flat is particularly valuable to the master painter for flat work. Because lithopone requires to be carefully ground in the proper percentages of certain reënforcing pigments, its use in the dry form by the master painter cannot be recommended.

Thorough grinding of the ingredients is necessary for the best results, and therefore lithopone products have thus far only been offered to the master painter either in paste form, similar to lead in oil, or mixed ready for use. Either form has much to recommend it to the practical painter and decorator, and his choice depends largely on conditions governing the work in hand. Furnished in paste form, ground in oil or varnish, or both, it can be thinned with volatile thinners to make a perfectly flat job, and can be tinted, as in lead to the shade required. In thinning paste goods with naphtha, which can be used wholly or in part with turpentine, it is advisable to use the heavier naphthas, or if these are not available, to add a pint or less of good, clean petroleum or coal oil to each gallon of naphtha to slow its evaporation and decrease the flowing properties of the goods. This does away with the piling up or ridging so common in flat work. If the thinner added to the paste dries too slowly, gasoline may be added.

In connection with the production of a flat paint it is well to bear in mind that lithopone will stand a greater amount of elastic binder in the vehicle, and still flat out, than other white pigments. Any of the white pigments may be ground in coach japan or japan and varnish, and produce a flat paint when the paste is thinned with volatile thinner, but the film so produced is not an elastic film, such as is produced when the binder is oil. It is generally necessary to stipple a flat white lead job, even though the lead has been drawn with turpentine and a considerable part of its oil removed; but lithopone, even though it takes relatively more oil in grinding than lead, will flat so perfectly that no stippling is necessary, even though all the oil used in grinding is allowed to remain.

Any additional care or expense involved in preparing a satisfactory foundation for the application of flat wall finish is more than offset by the fact that stippling is not necessary; the brushing is done much quicker; a wall finished with it can be washed a greater number of times than a lead-coated wall and without showing streaks and blotches, and when once a wall is coated with it, no special preparation is necessary beyond the usual patching and sizing incidental to the natural wear of the building, before flat wall finish can be applied again.

Lithopone is finer and shows more absorption for oil than lead does, but not as much as zinc.

Lead, 100 pounds, contains about four gallons oil, while 100 pounds of lithopone is said to contain eight and one-half gallons oil.

Lithopone of the best quality is lighter in gravity, and much bulkier than white lead. Ground stiff, it will absorb much more linseed oil, and will require a much larger container, owing to its much more bulky character. When mixed to a ready-to-use condition, it will have a considerably greater number of gallons per hundred weight than white lead mixed.

Many difficulties have arisen from discoloration of leadless paints, and many hard words have been said about them in consequence. This discoloration takes place with inferior makes of lithopone, or it may be due to the use of improper driers, or boiled oil containing lead driers. The finest grade when mixed with correct ingredients does not discolor, but keeps a beautiful white.

In this case the fault is undoubtedly due to the linseed oil with which the pigment has been ground. The remedy is to grind the color with the oil just before it is employed, and to use only oil of the first pressing, and which is as pale as can be obtained.

Some of Its Demerits.—It does not combine with the linseed oil in the same way as lead to form a tough paint film, and has a tendency to disintegrate more rapidly owing to its absorption of moisture more readily than lead. This defect makes it less protective in character for outside painting, and something must be done to repair, as far as possible, this weakness.

In pursuing my investigations into this subject, the question naturally arose as to what was necessary to strengthen leadless paint so as to make it compare more favorably with lead for outside use. Something seemed to be needed to act as a binder so as to toughen the paint film to a greater degree than linseed oil.

Tests have proved that a good strong high-grade pale varnish will materially help to effect this desirable result. There is little doubt that only with the addition of varnish will leadless white give satisfactory results outside.

Exposed outside as an oil paint, it is liable to chalk and disintegrate.

It must not be combined with lead; being a sulphide, the compound is liable to blacken.

There is one way in which lithopone can lose its whiteness and that is by the addition of white lead, litharge or lead colors. White lead is acted upon by lithopone so as to sulphate it and blacken the lead, so that it is important that for white paints you should keep them separate. If they should get together in old paint stock of darker tints, there is no harm, as they do not act upon each other to cause peeling.

It may be that some of the tests have proved greater failure than others, owing to lack of knowledge of the best method of mixing leadless paint. Much more oil should be used in mixing, and there should be a larger percentage of driers than is used in the mixing of lead, and a somewhat fuller coat should be given.

A large proportion of these flat finishes are very difficult to break up, probably due to some presence of rosin compounds that combine with zinc oxide. Most of them are composed of lithopone in combination with other pigments, some containing whiting. We found very few of these could be applied with ease. Most of them had a comparatively light petroleum thinner and would not flow out as the manufacturer claimed. Some contained lead and were off color.

Regarding Its Toxic Qualities.—There is absolutely no poisonous matter in the pigments. The liquid is universally a flat drying china wood oil varnish (in its essential composition) identical with most of the better grades of varnish ordinarily used by painters. There is nothing volatile or poisonous in such a varnish subjected to the heat of manufacture.

The volatile thinner is almost universally asphaltum spirits—that is, a heavy benzine with a high boiling point. The trouble comes from this ingredient, if it comes at all.

Doubtless the inhalation of benzine vapor in a closed room will produce the phenomena of ordinary smothering—insufficient oxidation of the blood; but it will not do so as quickly as the more volatile benzine ordinarily used by painters; nor will it produce the serious toxic effect of turpentine vapor inhaled in similar circumstances.

All painters, everywhere, constantly use paints and varnishes containing large percentages of the volatile thinners above described and all painters have heretofore habitually used white lead "flatted" by themselves by "washing out" a proportion of the oil with turpentine. They also frequently use the still more toxic wood alcohol in shellac varnishes, where it is employed as a denaturant of ethyl alcohol.

Any and all of these materials can, when used without ordinary care, produce disagreeable effects, and some of them, especially wood alcohol and turpentine, may involve serious consequences; but the least dangerous and the least injurious of them is the heavy gravity petroleum spirit used in flat wall finishes. This product is safer than the rest, not only because it evaporates more slowly and its vapor, being heavier, flows away more rapidly, but also because it is actually less toxic than the rest.

The remedy is ventilation—the ordinary natural ventilation dictated by common sense. If this be provided no ill effects can possibly accompany the use of these finishes. Furthermore, under duplicated conditions, they are less injurious than "flatted" lead, ordinary high-grade paint or first-class varnish.

Lithopone.—The two raw materials which are used for making lithopone are zinc metal, or spelter, and barytes. The zinc is brought into solution and the barytes is furnaced and converted into a clear, transparent solution of barium sulphide. When these two solutions of zinc sulphate and barium sulphide combine, the two metals, zinc and barium, exchange their acids.

The soluble zinc sulphate is converted into insoluble zinc sulphide and the soluble barium sulphide seizes the sulphuric acid from the zinc sulphate and is converted into insoluble barium sulphate.

Research laboratory work has proven that the resulting article is not a mere mechanical mixture of zinc sulphide and barium sulphate, but a close molecular mixture, so that we have the new product which we call lithopone.

The precipitated lithopone is dried and then ground in wood oil. In some lithopone factories the lithopone is thrown red-hot from the calcining ovens into cold water. It is supposed that it thus acquires a finer grain and more body, but this appears to be a mistake, and the practice necessarily involves a second filtration. The sulphide of barium used is seldom made from precipitated sulphate of baryta, and nearly always from the natural salt, heavy spar or barytes.

Notes on Lithopone Wall Paint

Flow it on more freely than white lead paint.

Lay it off like calcimine, not like lead paint.

Use a wide, flat wall brush—you can get over the ground faster.

A good paint does not set too quickly, hence one man may do a large surface.

If it does dry too fast, add a little raw oil, tablespoonful to the gallon; this will prevent laps and make it work easier.

Not more than 15% benzol should ever be used to thin out this paint. Raw linseed oil is best.

Cracks, etc., filled with plaster must be coated with shellac before sizing walls and painting.

Some brands of this paint make it possible to touch up missed or defective places after the surface has been painted, without showing the fact.

Never paint over a damp wall. If you have done so, then paint it over with white lead paint.

Common putty will show through this paint, so the putty should be made from dry white lead, whiting and gold size.

As liquid driers contain lead they must not be used with this paint.

Pigments based on lead will not do. For yellow use zinc yellow, and for blue use ultramarine blue. But any pigment free from lead can be safely used.

Don't brush out this paint, flow it on and brush as little as possible.

A painter says: "I have done many churches with this paint, but never follow directions of makers. First, I give walls a coat of white lead in oil, thinned with 1/5 turpentine; second coat, lead with double quantity of turpentine as oil; then I apply the flat wall paint, two coats as a rule. On some walls one will do."

FLOOR PAINTING

The floors usually painted, and the oftenest, are the porch and kitchen floors. Such floors experience hard service, hence the paint used must be hard and tough. The new porch floor should have its boards painted on the under side before laying, unless the location be quite dry normally. The edges should be leaded and joined while the lead is fresh. If the space under the floor be damp normally a coat of oil paint on the under side will resist rot, and will well repay its cost. The lead in the joins will keep out surface water, and should the seams here and there chance to open some, they may easily be closed with putty, each time repainted. This also will repay its cost. If the space beneath a porch floor is normally dry there will still be a certain amount of moisture in the air, caused by being enclosed and shaded continually, that will not injure the wood, but will keep the boards from separating so as to show open seams. This I have observed in my own porch floors, so that no priming is required there. Of course the painter cannot control the lumber producer nor the carpenter, but, given fairly good flooring, he can treat the floor so that its usefulness will be extended over many years. Let the floor become as dry as possible before painting it. This will develop cracks and other faults, so that they can be corrected in the painting. Usually the floor is formed of hard pine, but this is not always the case. Hard pine is difficult to paint, and it should be done the same as indicated for hard pine siding, which see. A pine having less pitch would be better for painting.

The paint itself must be a special kind, one that will dry hard and yet be elastic. The addition of some good copal varnish will give the paint these features, and the employment of pigments having a hard nature, such as the mineral pigments, ocher, for instance, will give a hard paint. Raw oil and turpentine furnish the thinners, with the proper quantity of driers. The primer for hard pine may be made from white lead thinned with turpentine, and a portion of oil. As stated under the head of exterior painting, hard pine priming might have some pure pine tar added, and is worth trying. The addition of a spoonful would at least do no harm. The thinners may be raw oil ¼ part, and turpentine or benzol ¾ part. Do not use more driers than is needed to properly dry the paint, and this will depend upon the weather or season. Too much driers softens paint, and this of course will not do. Rub the priming well into the wood and leave very little on the surface. Use thin priming. Thin the second coat with equal parts of raw oil and turpentine and driers sufficient. This forms a firm, elastic surface for the finish coat, if three coats in all are to be used. This finish coat may be made from white lead and zinc white, in oil, and a proportion of finely pulverized silica, also ground in oil, colored as desired, thinning out with a hard gum varnish to a brushing consistency. It is best to color the priming and succeeding coats a little, gradually working up to the finish color. This however is not always done, nor is it absolutely essential, but the practice has much to commend it, and careful painters like to observe the practice.

The following formula for dust color is a good example of what a porch floor paint should be as to its composition. Of course, any color may be used, as your patron may desire, but the preferred colors for this kind of work do not form a very large list; dust color, lead color and drab are mostly used.

Formula for Dust Color Paint.—Take of the following dry pigments: 25 lbs. zinc white, 5 lbs. white lead, 10 lbs. bolted gilders whiting, 1½ lbs. French yellow ocher, ¼ lb. lampblack; sift or mix all together and form into a stiff paste with raw linseed oil; thin out for use with a mixture of turpentine 5½ quarts, hard drying copal varnish 4 gallons, and driers sufficient, though litharge is better than japan driers in this case. Yellow ocher and finely ground silica add to the wear-resisting qualities of the paint; zinc white hardens it, but is a pigment liable to scale, hence must be used in moderation; varnish toughens the paint. Boiled oil must not be used, nor much raw oil, although I have done most excellent wearing floors with oil finish paint, only it will need repainting sooner. Some white lead is good, but not too much, as it is a soft pigment. Portland cement and plaster of Paris also are used in some formulas. Some prefer fine flour pumicestone to plaster. It is more porous.

Here is a formula for a buff color floor paint. American yellow ocher, dry, 35 lbs., whiting 5 lbs., barytes 5 lbs., Portland cement 9½ lbs.; all the pigments named are to be in the dry state; thin to a paste with raw oil, and thin to brushing consistency with turpentine and varnish, rather more varnish than turpentine.

Mr. Karl Holm, of Van Wert, O., writes us that the following formula was used in Germany where he learned his trade, and was esteemed as a very durable floor paint. Mix up some white lead with boiled oil to form a stiff paste, coloring as desired. Burn some old paint skins and grind the ashes in turpentine in a hand paint mill; their purpose being to harden the paint. Add sugar of lead for the drier and some turpentine, thinning out with boiled oil, which must be genuinely boiled oil. This paint is used for all the coats, the priming coat included, only using a little more turpentine for all the coats but the finish, which may be done with varnish, or not, as desired. This formula differs essentially from any we have employed in this country; the ashes and the boiled oil both are unique, but no doubt the paint was all that was claimed for it.

An old painted porch floor that has worn in places should be touched up with paint indicated for second coat of new floors; when dry, sandpaper off and apply finish used on new porches. It may need only the touch-up, or if bad enough better apply a coat all over floor and steps, after the touching-up.

Now we come to the interior floor. The kitchen floor is usually of hard pine, or other form of pine, perhaps one not so resinous as hard pine, and in consequence easier to paint. It is generally conceded that the painted floor is the best sort of floor for the kitchen—better than linoleum and cheaper. The painting and paint may be about the same as indicated for the porch floor, though a less hard paint will answer. Here is a formula for paint for a new kitchen floor. If hard pine, thin up some white lead ground in oil, using as thinners turpentine or benzol, preferably the first, as benzol is not very pleasant of odor and rather harmful too. This is the priming coat. For next coat, if a light colored paint is wanted, the base may be zinc white or lithopone ground in oil, with any desired coloring. The formula is thus: Beat up a gallon of zinc white or lithopone to a stout paste, add one-half gallon of good brown japan, beat up again to a paste, add a little turpentine, then thin out with hard copal varnish, one that dries in about 12 hours, thinning out to a proper brushing consistency. The third coat and last coat is of this paint.

A quick-drying coating for the kitchen floor may be made with shellac containing any desired coloring. But just at this time shellac is extremely high in price; likely a good substitute or a hard oil finish might answer. Use dry earth pigments with the shellac; and give two or three coats of a hard gum floor varnish, if only one coat of shellac is given. The outside floor can be finished natural too, of course, though it seldom is; apply a primer of three parts raw oil and one part turpentine, with driers sufficient. Let this have plenty of time for drying, then apply one coat of spar varnish.

An inside hard pine floor had better be shellacked first, as oil darkens the wood in time; two coats of shellac and a wax finish. Some like two coats of wax finish on the bare wood, rubbing to a polish.

If a floor or stairway must be painted so as to dry soon enough not to stop use for more than the night, color shellac with dry pigment and thin down with alcohol; apply two coats and give an hour between coats. Such a coating would allow of use in three hours, if needed. It certainly would be hard by morning.

PAINTING EXTERIOR WOODWORK

When pure white pine was the sole building lumber of our country painting was a very simple matter. It is an ideal wood for taking paint, and there is scarcely another to take and fill its place. To-day we have many kinds of lumber to deal with, and hence the difficulty of doing satisfactory painting; hardly two demand the same treatment. Some of these woods are not fit at all to take paint, yet we are obliged to paint it. But we do not guarantee results.

White Pine.—This is not the white pine that the grand old forests of Pennsylvania used to give us, and which was the best in the world, but so-called white pine, some of it fairly good, yet none of it as easy to paint as the old-time wood. It has more knots, coarser grain, not uniform of color, hardly white, and in general but a substitute. However, we must make the best of it. A recent writer says of this wood: "While paint dries well on this surface the lumber runs to occasional pockets, into which paint penetrates very slowly. Over the sap and pitch pockets the paint dries very poorly, and unless ample time is given for thorough drying over these places the paint will break loose in a very short time after the priming coat has been applied. These pitch pockets are easily detected by the paint spotting. Don't paint over such places until the paint has become perfectly dry."

The priming coat for white pine and all soft woods should be composed of white lead thinned well with raw linseed oil, with a little japan driers. Some add a little turpentine to assist penetration. Raw oil alone, with a little driers, is favored by some painters. But when lead is mixed with the oil we get both the filling of the wood tissue with oil, to preserve it and prevent undue robbing of subsequent coats of their oil, and some surface to work the second coat on. A formula given by some painters is as follows: White lead 80 to 90 per cent., raw oil 20 per cent., and turpentine 10 per cent. This formula can then be modified by adding more lead, and using it for the second coat. The third coat could have 90 per cent. oil and 10 per cent. turpentine. Most, however, omit all turpentine from the last coat. A master painter says: "In my practice I have found that the 10 per cent. turpentine enabled me to more fully control the application of the paint. Frequently, in the Eastern States, we are required to give new work three coats in addition to the priming coat. In this case my third coat consists of 85 per cent. raw oil and 15 per cent. turpentine. I would give the fourth coat 10 per cent. turpentine, in addition to the oil."

The following method for painting exterior white pine woodwork was communicated to me several years ago by an old and experienced Pittsburgh master painter, and for a white job that is to retain its fresh look for some years he said nothing could equal it. A large part of his experience with white lead paint was with the splendid river craft which operated between that city and New Orleans and other river ports. Such work demanded unusual care and ability of the painter, and a white paint that would stand there would undoubtedly stand on a house.

The priming coat consisted of white lead in oil, thinned at the ratio of six pounds of lead to one gallon of linseed oil, raw, and one pint of turpentine, with an ounce of powdered litharge as driers, the mass then to be strained, after thorough mixing, this being then well rubbed into the bare white pine, across the grain. Whether it was allowed to stand some time before application I failed to ascertain. The second coat was lead mixed with equal parts of oil and turpentine, omitting the driers. The third and last coat was made from white lead thinned thus: The oil is a drying oil, made by boiling a pound of litharge to a gallon of oil, allowing the oil to boil for 35 minutes, after which remove from fire and allow to stand over night. In the morning pour off the clear oil, leaving the sediment remain at the bottom of the vessel. This, he added, made the best drying oil known. He probably was not aware that the sediment, which no doubt he discarded, would make even a better drying oil if used again. At least that is what the chemists say.

Now the lead was thinned with this oil to a degree that would allow the paint to readily run from the paint paddle. Nor is this all; one-fourth of an ounce of beeswax is to be added to the oil while boiling, or else dissolved separately in some hot oil. This quantity of wax sufficed for a gallon of paint. The purpose of the wax is to prevent the paint from running and from chalking. The paint dries with a fine gloss, and under cover retains the gloss for several years, five or six. Of course this method demands some time and work, but seems to be worth it, where a strictly first-class job of white painting is desired. Color may be added. Less white lead seems to be required by this process than usual. My aged informant concluded his letter with the observation that chalking of white lead paint may justly be laid at the doors of the painters, who take no care to prevent it. He believed that the addition of a very little fat oil added to the life and beauty of the paint.

In undertaking to paint a new structure's exterior we must first of all study the character of the woodwork. In the following observations regarding painting the various woods, this matter will be fully discussed. We shall find some woods have a hard and close grain, while others have a soft, open grain; some soft and spongy, others compact and solid. Then the wood may have been kiln-dried, or it may have been air-dried. Too much heat and consequent rapid drying makes the surface of the wood hard and brittle. Such a surface cannot take ordinary paint well, it will not penetrate the shell. Air-seasoned wood is the better of the two, for it has dried in the natural way. Again, some of the lumber in the building may have been air-dried, the remainder kiln-dried, and that presents another difficulty in the painting. Taking these factors with others well known to painters and which will be taken up in subsequent pages, one not familiar with the subject gets some faint idea of what it means to successfully paint exteriors of buildings, saying nothing of the interiors. We have considered the painting on white pine, now we will proceed with the various woods in their order.

Bass Wood.—This wood is being extensively used in some parts of the country in place of white pine, and it has some of the best features of that wood, too. It has a close, straight grain of compact structure, is light of weight, soft but tough, and easy enough to season well; but it is not very durable. Paint dries as well on it as on white pine, and it takes paint very readily; but the priming coat should contain much oil and this with little driers, giving the oil plenty of time for soaking into the wood; apply with a full brush. and rub out well and evenly. In some places this wood is known as linn or linden. It has an even, white color, so that white paint covers easily and two coats will hide the wood completely.

Poplar Wood.—This is perhaps the best substitute we have for white pine. Its behavior with paint seems to be the same as that of the other wood named. It is soft, stiff, clear, fine and straight-grained, seasons well and shrinks very little. Paint dries very well on it. A carpenter informs me that poplar wood is inclined to warp, but this I think does not apply to both the yellow and white poplar. I have repainted houses built entirely of this wood, and found the wood in as good a condition as white pine would be with the same exposure and years of service—no warping that I could discover. Priming coat should be the same as indicated for white pine, and be applied the same.

Cottonwood.—While this wood resembles poplar in many of its features, yet it is less desirable, owing to the difficulty of seasoning it and its liability to warp, besides which it absorbs moisture readily, and exposure to the weather for any considerable length of time will result in its decay and darkening; it must be protected fully by paint. Being also subject to dry rot if any moisture is in it when paint is applied, the rot will proceed beneath the paint. The priming coat should contain plenty of oil and be allowed a long time for drying, so that the wood may become saturated with the oil, which will tend to preserve the wood from decay. Two-coat work cannot be done with satisfaction on this wood.

Elm.—A tough, fibrous, durable, strong, hard, heavy, and often cross-grained wood. While used extensively for heavy timber and structural work, it is not used to any great extent for exterior building. Heartwood, light brown; sapwood, yellowish white. Seasons moderately slow and takes paint readily on account of its fibrous nature. For priming, the reduction should be to a medium thin consistency, carrying sufficient turpentine to assist in penetration and working. The priming coat should be applied with a full brush and be well and evenly brushed out. The paint dries well on this lumber, but ample time must be given for thorough hardening. Satisfactory two-coat work can be done over this surface if judgment is used in reducing the priming coat, and the surface fully satisfied and evened up.

SPRUCE.—A house covered with spruce clapboards should not be painted until it has stood thirty days or more. If cracking or shrinking of the wood is to occur, it should be found out at this stage, and putty would remedy the trouble.

If a rain storm should thoroughly soak the wood, it would cause little or no harm. On the contrary, it would open up the pores of the wood that had been calendered or rolled down by the machine that cut and smoothed the clapboards, and afford a better foundation for the paint than the smooth hard clapboard.

A little more turpentine may be added for priming coats on spruce wood, as it is quite hard by nature. Five per cent. of benzol might be added for penetration.

It often occurs that the owner or builder of a new house insists on having spruce clapboards or weatherboards primed almost as soon as they are nailed on. In such cases cold water may be added to the priming color, about one pint to one-half gallon of paint. This water will not thoroughly mix with the paint, but will be distributed through it in small globules. The paint should be frequently stirred.

An old painter of my acquaintance frequently said that "the man who did not know how to use water in his paint did not know his business."

The addition of the water to the oil paint is to produce mechanical results, and is not intended in any way to cheapen the paint or to cheat the customer. Linseed oil paint, however well brushed, cannot be driven into the pores of hard spruce wood, especially if the wood is sappy. The addition of the water, when worked against the wood by the brush, opens the pores of the wood and gives the paint a firm lodgment. Moreover, sappy and wet clapboards painted in this manner will dry out flat, allowing a better foundation for succeeding coats, while pure oil paint will dry glossy on every clapboard where the fiber is hard or sap is pronounced. Such places will ultimately loosen and throw off all paint, as the pigment cannot attach itself to the fiber of the wood.

"If spruce is primed with yellow ocher instead of white lead it will cause blisters to form in 20 years from the time the paint is applied, if repainted once or twice during the interval. Spruce clapboarding primed and painted with white lead will very rarely blister, and then only when moisture from below causes the paint to lift up from the wood."—*Wm. E. Wall.*

Redwood.—This is one of the most difficult woods we have to paint, owing to its hard, non-absorbent heart growth, and the soft wood outside of the heart. In priming redwood, therefore, we must add benzol or turpentine to the paint, a popular formula being 30 per cent. turpentine and 70 per cent. raw linseed oil, adding also one-half pint of benzol to the gallon of priming paint. One-half pint of turpentine is deducted from the total of that fluid when the benzol is added. Add the benzol after mixing and when you are ready to use the paint, and not until then, as benzol is very volatile. Mix a thin primer and brush it well into the wood.

Redwood is thought by some painters to contain an acid, and that this acid prevents paint from wearing well. Acting upon this assumption an expert car painter tells how he overcame the blistering and peeling that paint applied to the wood underwent after only a few hours of exposure to the sun. He states that he primed the wood with raw linseed oil containing a pint of benzine to the gallon; this was allowed to remain on the wood about two hours, when it was rubbed off with a rag. The work stood then for five days, when it was given a coat of the following paint: To 15 lbs. flat lead color add 15 lbs. dry litharge, mixed as follows: Add enough best coach japan to make the litharge about like mush, then pour it into the flat lead. Stir the mass and run through a paint mill, make fine as possible, then thin to proper brushing consistency with turpentine, and apply three coats, one a day. This forms a hard and tough coating, proof against the acid of the redwood.

Cypress.—A painter puts it this way: "Cypress is a wood of a very peculiar nature; it is full of some greasy substance, so that when you give it a rub or two with sandpaper you find the paper clogged with a gummy stuff." It is indeed a peculiar wood to paint over, very different from all other woods. To prime it we need a paint that has super-penetrating powers; say 80 per cent. turpentine to 20 per cent. raw oil, the oil acting as the binder. Some prime the wood with benzol, and this seems a very good plan, as it softens up the gummy substance and causes the paint to adhere and dry better when applied. Or, use benzol in the paint in place of the turpentine. One painter says he primes this wood with japan drier; this gives a good surface for the paint, or priming coat. If an all-oil primer should be used the result would be that certain parts would not be dry, while the rest might be more or less dry. Driers help the drying, of course, yet on these gummy places the paint will not dry for days, proving that driers are not efficient in such a case. Interior cypress work should be primed with shellac. Rub this down and apply the finishing coats of paint. After the priming apply two or more coats of stiffish paint, well brushed in, and a little turpentine in each coat excepting the finish. This wood ought to be primed as soon as possible after coming from the planer, for any dampness will raise its grain and make the surface rough. Yet some prefer to let exterior work stand to the weather for some time, saying that it then takes paint better.

Yellow or Hard Pine.—As there are said to be 39 varieties of pine in this country one might suppose, naturally enough, that there would be about 39 ways of painting pine, but not so, for it appears that they all are very similar of structure, being hard, heavy, tough, strong, compact, coarse and resinous, one as difficult as the rest as to painting. The primer should be white lead thinned with raw oil 30 per cent. and turpentine 70 per cent.; in fact, just the same as indicated for cypress, which see. A two-coat finish is not feasible on this wood, because one must apply the paint quite thin, and hence it will require at least three coats to cover well. One prominent fault with painted hard pine is the scaling off; this is caused by the failure of the paint to attach firmly to the wood. To overcome this add one part of pure pine tar to seven parts of pure raw linseed oil; mix the primer paint with this fluid and rub it well into the surface. Then allow a long time to elapse before applying the next coat of paint; the second coat is made of white lead mixed thin with oil and turpentine, and some driers; if it is to be white finish then add a little lampblack to the second coat, which will make a more solid-looking surface than where the white alone is applied. Three coats should make a good finish. Heavy paint will result in blistering on this wood, hence thin coats.[1]

A painter says he did a job on hard pine, which he sandpapered and shellacked and then painted, but the paint would not adhere right; he then removed the shellac and paint to the wood, scraped and sandpapered the wood, then primed with equal parts of white lead in oil and dry red lead, thinning with two parts raw oil and one part turpentine, mixing the paint very thin. He strained this paint and rubbed it well into the wood. Allowing it to become hard-dry he applied two coats of white lead paint, made in the regular manner, and had no further trouble with the job.

Many expert painters agree that this wood, on exterior work, will receive paint better if allowed to stand to the weather for a time, say two or three weeks, during which time weather that consists of sun and rain will draw out the sap and open the pores of the surface wood. But where the painting must be done at once the use of the torch is suggested, which will draw out the sap, which in turn can be scraped off. Then prime with equal parts of white lead and red lead, thinned with a little oil, but mostly with turpentine. Some use red lead alone, but red lead forms a too-hard surface, one that is not calculated to hold the next coat of paint well. Some red lead with the white lead no doubt does good, as one painter states, causing the whole paint to stick to the wood. A coat of benzine to the bare wood is advised by some, others using benzol. One painter tells us that a coat of ben-

[1] An experiment was made in 1900 in which a square, 100 feet, of Georgia pine, was nailed up on a southern exposure and primed with a mixture of pine tar one part, boiled linseed oil 3 parts, without addition of pigment. When perfectly dry it was finished with two coats of white lead thinned with boiled oil. Examined after three summers, it was found in good condition, no checks, cracks or chalking. It had long been the opinion of the experimenter that clear oil priming on either wood or iron was better than a paint.

zine to the bare wood, letting this stand a week before priming, insures a durable job. It is thought that on almost any other wood the priming with benzine would cause the paint to scale, but this has never been definitely established, as far as I know.

Under all conditions, in priming hard pine, thinner mixtures and more turpentine must be used than would ordinarily be employed in priming a hard surface, the amount of turpentine varying, according to the run of lumber, from 25 to 40 per cent. of the total amount of thinners used. Do not be afraid to use turpentine freely with this lumber, as this vehicle restores the life or vitality which nature has given it.

Turpentine will assist in opening the pores of the wood and give greater depth of penetration, as well as carrying or driving the sap into the wood to a greater depth of binding on the hard or fat places.

Apply the priming coat with a full brush and brush out well and evenly. Do not allow the brush to slip over the hard places, but work the paint well in. Extra care must be taken in brushing over this surface in order to even up the priming and not have too much pigment on the hard parts.

Paint dries slowly on hard pine, hence plenty of time must be given it to become hard-dry, with the wood taking up all it can of the thinners. In the cases of Oregon and Idaho pine it would be well to increase the percentage of oil to 55 per cent. for the priming coat, reducing the amount of turpentine in proportion, but allowing the full proportion of benzol. The absorption is very uneven, varying from quite rapid on the clear, soft parts to very slow on the hard or fat parts. More trouble arises from the efforts made to hide the surface with heavy coats than from almost any other cause.

It should be observed here that where hard pine is to be placed against a wall, as in wainscoting, the back of the wood should be given a coat or even two of white and red lead and oil paint. Some turpentine also will improve it.

How to do Good Painting.—Year by year the difficulty of doing good painting increases. The difficulty is mainly due to the character of the lumber that is now used in building construction, even including the best work, because we do not get even the poor lumber direct from the log, but must use stuff that comes from what the lumber cutters left behind them, forest culls, timber sappy, full of windshakes, knots, etc., and, through long water-logging or decay, soft and punky. Lumber is now being used for weatherboarding that a few years ago would hardly have been accepted for rough barn work. Lumber not so long ago considered unfit for exterior construction, hard pine of various kinds, spruce, cedar, bass, gum, redwood, and the like, woods either full of pitch or rosin or soft and spongy. In addition there is a scarcity of properly seasoned lumber; much of that used is either full of sap or moisture and is sure to cause paint to leave its surface, once the sun gets at it. Then there is the lumber that has been kiln dried to excess, which renders it like a sponge; such a surface soaks up oil to the limit. If the painter understands this feature he will mix his priming with plenty of raw oil and some turpentine, so that the paint will penetrate the wood; he will rub the primer well into the wood, and not leave much paint on the surface. If he is not careful about this he will have a surface that will shake the paint off in time, simply because the paint film will lack oil to bind it on. Frequently, too, no thought is given to the proper thinning of the primer for hard pine or similar woods, fat with gum or rosin, as it is called, and the result is that the sun heats up the rosin and causes it to run, taking the paint with it; in another place I shall describe the proper way to prime such woods. The primer that does for a soft pine will not do.

Let it be remembered, then, that to insure good results on new or very old, spongy surfaces, there must be sufficient pure raw linseed oil used in the first and second coats of any paint to properly fill the wood and arrest the absorption of the oil and binder from the paint film, and still leave enough oil to bind the pigment thoroughly; and that where any new surfaces are hard and resinous, a liberal percentage of turpentine must be added in first and second coats to insure adequate penetration and assist the drying to a proper "face" or surface for recoating.

That on old work that has been previously painted and presents a hard, impervious surface, equal parts of pure turpentine and pure raw linseed must be used in reducing the first coat to a thin consistency to secure proper penetration and homogeneous drying of the new coat of paint. That "elbow grease" must be used to spread any paint out into thin coats and brush it well into the pores of the wood, and unless so spread, satisfactory results cannot be insured.

That a much more satisfactory and durable job of work can be done with a round or oval brush than with a long, wide wall brush. That under no circumstances should a new house be painted before wet basements or the plaster have dried out. It should be borne in mind that every yard of green plaster contains nearly a gallon of water, and unless thorough ventilation is given and the moisture is allowed to evaporate and escape in that way, it must necessarily escape through the siding (which may have been thoroughly dry when put on) and the result must inevitably be blistering or peeling.

That painting during or following soon after a dew or heavy frost or fog, or in any heavy, damp atmosphere, is likely to produce unsatisfactory results, as dry siding absorbs moisture very rapidly. That to the greatest extent possible, painting in the direct heat of the summer sun should be avoided. Paint on the shady sides of a building as much as can be done.

Painting around fresh mortar beds should be avoided on account of the tendency of the oil in any paint to absorb the moisture and fumes from the lime, destroying the life of the oil and causing the paint to flat out and perish. Remember not to apply one coat of paint and let that stand a year or so before a subsequent one is applied. It will have weathered sufficiently in that time to absorb some of the elasticity of the succeeding coat, so that the final result cannot be satisfactory.

Again, don't apply a coat of paint and let it stand until it is bone hard before continuing the work—one coat should follow another within a reasonable time until the work is finished. If the under surface is allowed to get too hard, it will not have the proper "tooth" to allow the succeeding coat to get a "grip" or hold on it.

Some Paint Formulas

Old Interior Work.—Taking the 100 lb. keg of white lead as the unit, we will indicate the kind and quantity of liquids necessary to reduce it to the proper paint consistency. In the first place let it be understood that the old work must be made fit to receive the coats of paint. Interior painting is usually done in either gloss, egg-shell gloss, or flat paint. For the first coat, no matter what the finish is to be, take 100 lbs. white lead and thin up with one gallon of pure turpentine, one pint of turpentine driers, and if this paint is to go on an old gloss surface add a quart of white mixing varnish, to prevent crawling. If the finishing coat is to be a gloss, to 100 lbs. of white lead add four gallons, a little more or less, as the case may require, one pint of turpentine, and one pint of white turpentine japan. If the finish is to be egg-shell gloss, use three gallons of turpentine and one pint of white turpentine drier to the lead. If the finishing coat is to be dead-flat, draw the oil from 100 lbs. of white lead, and thin the lead with three gallons of turpentine and add a pint of white turpentine drier.

New Interior Work.—The first or priming coat should be mixed with white lead, 100 lbs., five gallons of pure raw linseed oil, and one and one-half pints of turpentine japan driers. Second coat, 100 lbs. white lead, one gallon pure turpentine, two or three gallons raw linseed oil, and one and one-half pints white turpentine drier. If the finishing coat is to be in gloss, break up three pounds of white lead in turpentine, enough to form a smooth paste, then add a gallon of white enamel varnish. If the finish is to be egg-shell gloss, mix together 100 lbs. white lead, three gallons turpentine, and one pint of white turpentine japan drier. For a dead-flat finish, same as for old interior work.

For Either Old or New Work.—If it is desired to get a clear white or some delicate tint which will not turn yellow, avoid oil in all coats but the primer. For a flat finish mix second and third coats for new work, and both coats for old work as follows: 100 lbs. white lead, three gallons turpentine, and one-half gallon of white mixing varnish. If more gloss is desired, increase the proportion of mixing varnish and reduce the quantity of turpentine.

For Exterior Painting. In presenting these formulas let the reader understand that they are general, rather than otherwise. The painter will understand, of course, that conditions vary, and hence paint and application must vary also. However, the proportions given will serve very well as basis for estimates. Certain woods, such as bass, linn, white pine, etc., require more oil than is necessary for hemlock, yellow pine and spruce. The wood should be perfectly dry before application of paint.

Old Exterior Work.—Priming coat, 100 pounds white lead, four to five gallons raw linseed oil, one gallon turpentine, and one pint turpentine japan. Second coat, 100 lbs. white lead, about four gallons raw oil, and a pint each of turpentine and turpentine japan.

New Exterior Work.—Priming coat, 100 pounds white lead, six to seven gallons raw linseed oil, one to two gallons turpentine, and one and one-half pints of turpentine japan. Second coat, 100 lbs. white lead, four to four and one-half gallons raw linseed oil, one pint turpentine and one pint turpentine japan driers. Third coat, 100 lbs. white lead, four to five gallons of raw linseed oil, and a pint each of turpentine and turpentine japan driers.

The amount of driers necessary will be indicated by season and weather, also where much turpentine is added as a thinning agent less driers will be needed.

REMOVING OLD PAINT

Fire and certain chemicals act upon old paint to make it soft, in which condition it may easily be removed by scraping. Just which remover may be the best must be decided by circumstances. Probably the best all-around paint remover is the old gasoline torch. Prior to its invention painters used the charcoal burner, a sheet iron small stove that could be managed by one hand, the other hand being free to do the scraping. A charcoal fire was maintained in this burner, and while it did soften the hardest paint, yet it was hard to handle, clumsy, and had a habit of setting fire to the operator's clothes. The torch was a great improvement, and today is the best burning-off tool we have. But it has its disadvantages too. It has set fire to many a building, through the carelessness of the operator mainly, who has used it under old cornices, for instance, where the flame has come in contact with loose combustible material and so set fire to the building.

If you have a job of burning off on an old frame structure, select a still day. Be very careful, and remember that should you set the building afire it may cost you something. It is possible for a tenant to sue the painter for damages, should the latter set fire to the property, thus invalidating the fire insurance, for the owner of the property could not be sued.[1]

[1] The use of a benzine or naphtha torch to burn the old paint off a building preparatory to repainting has been held to be an increase of risk which voids the policy. An essential element in the case, however, is that the owner of the building shall

Don't rush the scraper; let the torch loosen up the paint, then follow with the scraper, a broad and not sharp blade. Take the torch in one hand, the scraper in the other. Wear a canvas glove on the right hand, to protect it from the blaze and hot scrapings. Keep nozzle of torch about two inches from the paint, and when burning off weatherboarding throw the flame downwards. Set your knife back of the flame, not too slanting, and push gently, do not force it. When the paint is soft it will need no pushing of the scraper. Take long strokes, not short ones.

For columns, moldings, etc., instead of a knife use a wire brush; when the paint is quite soft give the brush one quick forward and backward stroke.

After removing the old paint sandpaper the work, shellac any knots, then apply a primer of white lead thinned with raw oil ¾ and turpentine ¼. If the old paint is cracked and too dry to soften under the heat of the torch, give it a coat of benzol to soften up the hard paint.

An expert master painter says of the torch burner: "I have as yet to find anything that will answer the purpose of removing paint as well as the burning-off process. An expert workman can remove twice as much paint with the torch as can be removed with the commercial paint removers; at the same time he will make a cleaner job. The torch does the work at a great saving over that of the paint removers."

How to Clean the Torch.—To do its work at its best the gasoline torch must be kept clean. If it does not work freely and with force, it's a waste of

have knowledge that such a torch is being used. If painters should use a naphtha torch for the purposes mentioned without the knowledge or consent of the owner of the building and the party holding the policy, the companies would probably not be able to escape liability. But when the owner is aware of what is going on and permits it he forfeits his insurance.

time to keep pricking at the nozzle with a needle; take the top off with a wrench and unscrew the nipple with stout pincers, and likely you will find it choked with grit. Screw it up tight before using it again.

When burning off with the torch have a bucket of water handy, in case of a blaze.

How to Use Paint Removers.—There is a right as well as a wrong way to use liquid paint removers. The right way is to apply it freely and then let it do its work. The wrong way is to apply the remover, then at once begin to scrape at it. Brush it on one way only. Don't brush it back and forth after the remover has been applied, for this injures its solvent power; just let it alone for some time. Then try it with the scraper, and if still not soft enough apply more remover, putting it on one way and gently. Do this until the mass of paint has softened clear to the wood; then it is ready to scrape off. You will save time and money by following these instructions. Ordinarily the remover will soften up old paint in a few minutes, but some cases require much longer time. For outdoors work use the thick liquid remover, especially on upright work; this is to prevent running of the remover. The removers come in various degrees of density from a thin cream to a syrup. There are the paste, the semi-paste, syrup, and cream removers; ask the dealer for the one you need. If you require a slow-drying remover, one that will remain moist for one or two days, get the thick sort.

Alkali Removers.—The strongest alkali remover is that made from lime and concentrated lye, mixed to a paste with water. Sal soda and fresh lime, in equal quantities, make a good remover. Take a pound of sal soda and one pound of fresh slaked quick-lime, dissolve the soda in water and then add the lime to it. For paint that is not very old and hard, plain strong sal soda in hot water solution does. Make a paste from half-peck of fresh slaked lime, 20 lbs. of potash, or caustic soda, and 8 gal. of water. Concentrated lye and caustic soda are one and the same thing; caustic soda is cheaper than potash. Concentrated lye is a strong remover; take a box of the lye and mix with ½ gal. of water, rain water by preference, and let it stand until dissolved.

PAINTING BY AIR-SPRAY MACHINE

There are various forms of machines for spraying paint, air machines of low and high pressure, some operating by power, others by hand. The principle in all is the same. The paint is in a finely strained liquid form, and is forced through a fine nozzle under air pressure, the paint assuming a fine mist form, some of which floats away, but the major portion reaches and attaches itself to the surface that is being coated. A hand machine of from 150 to 250 lbs. pressure is a good size for general use; it should be made as light and compact as possible, though strong and durable. Many of these machines are made to sell, rather than to give the best service. Some require very frequent repairs and attention; this will of course necessarily increase the cost of doing painting of this character.

A sprayed job of painting when well done is very satisfactory, and in some respects at least is superior to hand-brushed work. It shows no brush marks or laps, it penetrates cracks and very fine crevices. As to comparative cost, machine work, it has been estimated, can be done for one-half the cost of hand or brush work on any job of fairly good size. The machine is for large surfaces and jobs, and on ordinary jobs, such as a room or dwelling, the saving over hand work would be very much less. On jobs requiring several men and three or four days, it will pay to use the machine. Some dislike the machine because it sends the paint everywhere, as its opponents claim, but this can be entirely avoided by means of cloths and careful spraying. Then there are the drops or nipples left by it on the lower edges of beams and rafters, but this fault has been mostly done away with by the men having learned how to avoid it, so that now one may go through a building that has been painted by the machine in the hands of experts and not see any such faults.

There is one thing important to remember when running an air spray machine; the moment it stops all hands stop with it, for the work stops. On difficult work it is often advisable to send an extra man to handle the nozzle, so that the men can alternate and keep the machine going all the time; by so doing you will more than make up the extra cost by the increased amount of work done.

Care must be exercised in mixing and straining the paint, in order that the machine may not clog, which means loss of time and money. If you are using water color, and this is what is mostly used, have the mixing handy as possible to the water where you do the mixing. This saves time in carrying water a distance. These things all count for or against your profits. Again, you can paint a seven-story building by the machine and never move it from the basement; this is done by using sufficient hose to reach the top floor, and taking off hose as you descend to lower floors. This is also advised at the end of the day's work, in order to clean out all utensils and clean up for next day's work.

It has been found best to have at least four men on one machine, two to alternate at mixing, straining and supplying the machine, and also to do the pumping, while the other two men do the spraying. On small jobs four men would be too many, they would not have a full day's work. The man at the spray end of the machine should be well experienced, but those who assist need not be experts. The head man must know how to mix and apply the paint. The longer a man works at this the more expert he becomes, particularly on extension work.

The question is sometimes asked, How much brush work is necessary with the air machine? The only place likely to need hand work is around door and window frames. They used to cover doors and windows with material of some sort, paper or muslin, but this is unnecessary where an expert directs the spray.

Since writing the above concerning paint spraying, in preparation for this edition of "The Expert House Painter," we have been favored with a full report on very extensive and careful tests that have been made with spraying machines in competition with hand brush work at Washington, D. C., on Government buildings. The report says:

"The machine used in the experiments consisted of a 4 h.p. motor, a large air tank, and a 5-gallon paint tank. It required 220-volt direct current. For the roof work the paint tank was hoisted to the roof and two hose leaders were carried from the air tank located on the ground. Two operators could work at the same time with the paint tank which was fitted with two spray guns.

"For the exterior work an experienced spray brush operator started the work on one side of the building and two journeymen with 4½-inch hand brushes started the work on the other side, which was a duplicate in size, shape and construction of the side selected for the spray test. After the work had been started a journeyman painter entirely unfamiliar with the use of the spray gun was shown how to operate it. He completed the tests, including the walls and roof area. It was apparent that a very short period of time was required to instruct a man to use a spray gun. The tests were of good size and included on the side walls an area of over 8,000 feet and on the roof an area of nearly 9,000 feet.

"The paint used for the exterior wall work was a lead paint tinted with ocher, weighing 17.6 lbs. per gallon for the first coat and 20 lbs. per gallon for the second coat. Both paints were easily handled by the spray gun. The paint used on the roof was an oxide of iron paint weighing about 14 lbs. per gallon. The paint used for the interior work was a modern sanitary flat wall paint of the lithopone type, weighing 14 lbs. per gallon. It was apparent that the spray gun would successfully handle paint of practically any weight per gallon.

"In doing the first coat on the exterior brick walls, all cornices and trim were cut in with the spray on the side of the building where the spray test was made. On the second coat, however, the cornices were cut in by hand with a brush, in order to assure a neat job. The time of the brush work was counted in as spray-gun time.

"It has previously been assumed that the average journeyman painter, working on wall surfaces and using a hand paint-brush would do about 200 square feet an hour, or about 250 square feet an hour on roof work. It will be noted in the attached tables that apparently much greater speed was attained in the hand-brush work. It is assumed that this was due to the great interest of the painters in the test.

"Observation of the completed work showed that practically no difference in the appearance of the spray and the hand-brush work existed, with the exception that the spray work was slightly more opaque. The painters in applying the paint by hand with 4½-inch brushes used drop cloths at the base of their work, whereas no drop cloths were used by the spray workmen. There was apparently little paint falling to the ground, the only loss being in the form of a fine mist. On a damp day this mist, of course, would be greatly intensified, due to the presence of the volatile constituents of the thinner. The mist was of a somewhat colloidal character and the effect was largely optical. On the interior work, however, a noticeable difference was shown. The mist in the room where the paint was being applied by spray guns was very noticeable. Drop cloths were required on the floors in order to prevent staining.

"On the interior tests, one room was done by two painters with hand brushes and two rooms with the spray gun by one operator. The rooms faced a courtyard in which the machine was placed with hose leaders running up to the work. The ceilings of the rooms were arched, four arches meeting in the center of each. This made the painting rather difficult by hand, but very much easier for spray work. The side walls had four projecting columns, one at each corner, and between the tops of these columns and the arched ceiling there was a heavy scroll cornice. Each room also had a fireplace and chimney breast and large recessed combination windows. The hand work was somewhat marred by streaks and the covering was very poor. The spray work was greatly superior. A very much heavier coating of paint was apparently applied. It was necessary to put on two coats of paint by the hand brush in some instances in order to get satisfactory covering."

EXTERIOR WORK

Previously Painted Metal Roof

	Area of Surface Sq. Feet	Paint Used Gallons	Time 1 Man Hours
Spraying	578	1.49	.5 (½)
Brushing	578	1.35	1.5 (1½)

Results Calculated to 10,000 Sq. Ft.

Spraying	10,000	25.8	8.6
Brushing	10,000	23.3	25.9

Comparative Cost of 10,000 Square Feet of Work

Spraying 25.8 gallons Paint at $4.00	$103.20
8.6 hours Labor at $.90	7.74
	$110.94
Brushing 23.3 gallons Paint at $4.00	$ 93.20
25.9 hours Labor at $.90	23.31
	$116.51

Spraying Requires Approximately 10 Per Cent. More Paint than Brushing.

Brushing Requires Approximately 200 Per Cent. More Labor than Spraying.

EXTERIOR WORK

Previously Painted Brick Walls and Stone Cornice

	Area of Surface Sq. Feet	Paint Used Gallons	Time 1 Man Hours
Spraying	8,364	10.8	20.
Brushing	8,188	9.87	41.

Results Calculated to 10,000 Sq. Ft.

Spraying	10,000	12.90	23.9
Brushing	10,000	12.05	50.

Comparative Cost of 10,000 Square Feet of Work

Spraying 12.90 gallons Paint at $4.00	$ 51.60
23.9 hours Labor at $.90	21.51
	$ 73.11
Brushing 12.05 gallons Paint at $4.00	$ 48.20
50 hours Labor at $.90	45.00
	$ 93.20

Spraying Required Approximately 7 Per Cent. More Paint than Brushing.

Brushing Required Approximately 109 Per Cent. More Labor than Spraying.

Interior Work

Combined Ceilings and Walls of Plaster

	Area of Surface Sq. Feet	Paint Used Gallons	Time 1 Man Hours
Spraying	2,600	6.39	5.33 (5⅓)
Brushing	1,000	1.75	5.33 (5⅓)

Results Calculated to 10,000 *Sq. Ft.*

Spraying	10,000	24.5	20.5
Brushing	10,000	17.5	53.3

Comparative Cost of 10,000 *Square Feet of Work*

Spraying 24.5 gallons Paint at $4.00..............	$ 98.00
20.5 hours Labor at $.90.................	18.45
	$116.45
Brushing 17.5 gallons Paint at $4.00..............	$ 70.00
53.3 hours Labor at $.90................	47.97
	$117.97

Spraying Required Approximately 40 Per Cent. More Paint than Brushing but Gave Quite Good Hiding in One Coat.

Brushing Required Approximately 160 Per Cent. More Labor than Spraying and Gave Poor Hiding in One Coat.

PAINTING BRICK WALLS

New Walls.—Brick walls vary according to the quality of the bricks and their laying. Usually a new brick wall is left unpainted, unless it is desired to keep out rain or dampness. Where a residence, for instance, is finished in the finest pressed brick it is not essential to its adornment that it be painted, but with the lapse of time the application of flat brick paint will greatly enhance the appearance, and this is done to a great extent in some cities.

Any brickwork that is to be painted, for the first time, must first be made perfectly clean, by scraping and brushing down, to remove all loose parts and dust. Then it should have plenty of oil: two coats of thin oil paint. Some add half-and-half of oil and turpentine for the second coat, which will penetrate better than oil alone. My preference is for all oil, no turpentine. Having applied the two coats, all parts needing it may be puttied. This putty should be hard-drying, a putty of whiting and white lead combined. Now if the finish is to be in flat color, this may be one of the commercial or prepared flat brick paints, which are very desirable; thin out with turpentine, as usually directed on the can, and one coat should give a good solid finish. This paint is very thin, and requires nice brushing to produce a perfectly solid surface. Use a bristle wall brush, taking a stretch across the wall, working from a stage. There should be men enough to do the work so that no laps will be possible. Quick work too is required.

Some painters say that as much as one-half oil in the flat finish will give a good dead effect, and no luster, while others advise the addition of some soap to the last coat, saying that it will make it flat, even though it contains much oil. Neither of these suggestions appeal to me, for the regular flat brick paint, that thinned with turpentine only, wears very well.

Preparing a Wall for Flat Paint.—This has been briefly explained in the foregoing, but a few words in addition will be found useful. In some cases the walls may be much broken, and require other than putty for the filling. In which case plaster or cement may be used. For the priming coat add some dry Venetian red to raw linseed oil and dose the bricks well with it. Rub it in well. A round paint brush is best for this work, one that has been used to break it in is best. A good formula for this priming coat is Venetian red 20 lbs. and raw linseed oil 10 gals. This coat should have about two weeks for drying. Then apply a coat of paint made from Venetian red in oil 75 lbs., white lead in oil 25 lbs., and Indian red in oil 3 lbs. Mix thoroughly and let it stand 24 hours, then it is ready for use; thin out with raw oil with enough turpentine to somewhat deaden it, and then let it have several days for drying. Then it is ready to receive the finish of dead flat paint and the striping of the joints.

Where brick work is painted in dead flat it is usual to line the joints between the bricks, to make the effect of mortared joints. This is a very particular job, very difficult in the hands of the inexpert, but who with care may do very fair work. The following description of this work will greatly help the inexpert painter, by carefully following instructions. The work is best done from a stage. White paint for lining is made from white lead in oil, with a little driers, and is mixed rather stiff, or rather stouter than ordinary white paint. Fill a pound brush with this white paint, holding it in the left hand, which also is to hold the straight edge, a narrow and beveled wooden strip, and you are ready for work. First, there are two kinds of lining brushes for this work, one for the long lines, across the face of the wall, the other for the vertical short lines. The first named tool is known as the liner, the other is the header. So with paint brush in hand, lay the beveled rule along the top edge of the row of bricks, and filling the liner with paint from the loaded paint brush, carefully draw the liner along the edge of the rule as far as it goes. After doing several of these lines use the header for joining them at the ends of the bricks. Draw the liner firmly but not too hard along the straight edge, which hold true to the line of bricks. Some have a straight edge with a small level attached, which enables them to get a true horizontal line; but this we do not think will as a rule be necessary, for all you will have to do is to get the general line of the bricks, using your eyes, too, in order to get straight-appearing lines. In the best work the practice is to run the line along the top edge of the bricks, just beneath the mortar; this because the brick is smoother than the mortar.

The liner is a thin brush two or three inches long, while the header is much shorter; both are made with hog bristles, short and stiff.

Brick Color Formulas.—In making brick paints remember that French yellow ocher is used to produce the lighter shades of brick color, with the addition of a little blue for intermediate shades, while for the dark shades much blue is used; the pigment used is Prussian blue. By varying the proportions of these colors we get many different shades of brick color.

Red Brick.—White lead 4 parts, Venetian red 2 parts, Indian red 1 part.

Pressed or Philadelphia Brick.—White lead 4 parts, Venetian red 2 parts, Indian red 1 part.

Dark Brick Red.—Add Prussian blue to the above.

Cream Brick Color.—Take white lead and yellow slightly with French yellow ocher, then add a very little raw umber.

Buff Colors.—These may be made from white lead, yellow ocher and raw sienna, varying the proportions so as to give the shade desired. The addition of a little raw umber will give a Milwaukee color.

Painting Old Brick Work.—The principal trouble to be apprehended in the painting of an old brick wall is the possibility of its peeling, or blistering, but this may be avoided if the work is carefully scraped and made clean. A stiff wire brush is good for removing scale and soft parts, after which a good sweeping down with a broom is well. If the work has once been painted the preparation will be regulated by the condition the wall is in. All defects must be puttied or cemented smooth and tight. Raw linseed oil is always the best liquid that can be used on brickwork, and the more the better. A little Venetian red may be used with the priming coat, though some painters use only the oil. This priming coat should have plenty of time for drying hard. Use driers with it. After it is dry apply a coat of paint composed of the color the finish is to be, though in any case some white lead should be used with it, say, a third of the lead. Thin this with a mixture of two parts raw oil and one part turpentine, with driers. The third coat may be composed of such pigments and color as desired, but thin with real boiled oil and a very little drier. This will give a good wearing surface with a gloss effect. Usually Venetian red is used on such work, but the addition of lead does not affect the red color, while it gives body to the paint.

Some first-coat the old work with a paint made up of old paint skins or fat paint, thinned and strained, using oil and turpentine, or benzine, and applying the paint very thin. This would no doubt do a very good job, filling the coarse work full of pigment and making a solid foundation.

Brick painting should be done only in dry or fair weather, if possible, and the bricks should be dry. Otherwise there is danger of scaling of the paint.

Removing Old Paint.—Where the old paint is not in good condition, or not firmly attached to the bricks, it must be removed. Scraping offers one good method. Or the paint may be burned off with the torch, or by means of strong lye.

A brick wall naturally damp will offer a poor surface for paint. It might be treated with the Sylvester solution, and I think this would give good results. Any dampness in a wall will show in time, after the painting, in a faded appearance, and finally in the peeling of the paint. Paint will protect a dry brick wall from outer dampness, rain, etc., and often this is the reason for the painting. Water enters bricks and in winter the water will freeze and chip the brick.

Where a brick wall is painted for the first time it should have at least three coats of paint, including the priming coat. This priming coat may be made in the proportion of 100 lbs. white lead, thinned with 9 gals. boiled oil and 1 gal. turpentine. This where white lead is desired rather than Venetian red for the first coat. For the next coat 4 gals. oil, 1/3 boiled oil and 2/3 raw oil, to the 100 lbs. of lead. The last coat may be rather heavier than this.

To Clean Pressed Brick Front.—Make up a cleanser composed of soft soap 1 gal., powdered pumicestone 2 lbs., and strong ammonia 1 pint. Apply in a thin paste form, using a fiber brush, and let remain on about 20 minutes or so, scrub well with hand scrub, and finally wash off with clear water. Use plenty of water.

Green Mold, Mildew, Etc.—Wash off with an acid water and stiff scrubbing brush. Sulphuric acid is good for the purpose, but add it very slowly to the water, do not pour the water on it.

Smoked Painted Brickwork.—Use the formula indicated for cleaning pressed brickwork. First remove all loose smoke and dirt with a fiber brush or broom. Rub the alkaline solution well into the work with a fiber whitewash brush and let the stuff remain on for a half-hour or so. Then rub it briskly with the brush, dipping the brush in clear water once in a while. Wash off with plenty of fresh water, using a large carriage sponge. A hose with spray nozzle is fine for rinsing off with. This treatment usually removes all soot, etc., stains. Sometimes an acid wash is good, following the alkali wash.

Brickwork Turns Black.—This does not often occur, and its cause does not seem to be known. It may be due to dampness or to impure oil used in the paint. As it appears in spots it may be mildew. Various remedies have been tried on it, such as kerosene oil. Heavy paint containing some varnish has been tried, but in vain. It occurs both when the wall is dry and when it is damp, in dry as well as in damp weather. This does not look like mildew.

Brick Efflorescence.—There are at least three different causes for this. On new work, carbonate of soda is the most common, after the lime-stains have been removed. This is due to the action of the lime mortar upon the silicate of soda in the bricks. Silicate of soda seldom occurs in bricks unless the clay used is a salt clay. The only other white efflorescence of importance is composed chiefly of sulphate of magnesia. This is due to pyrites in the clay, which when burned give rise to sulphuric acid, and the latter unites with the magnesia in the lime mortar. The conclusions arrived at are these: Efflorescence is never due to the bricks alone, and seldom to lime alone. To avoid it the bricks should be covered with an oily preservative capable of preventing the salts from exuding. Linseed oil cannot fill the requirements, as it is injurious to the mortar.

Efflorescence or white powder on bricks may be treated with hydrochloric acid and water, equal parts; let dry, then wash off with clear water.

Cleansing Brickwork.—To clean yellow bricks from stain and smoke take freshly powdered lime and sift it; take 100 parts of this and add water to form a thin milk of lime; boil in a copper boiler, and add 1 part bichromate of potash. Now mix up some lead sulphate in water, making a thin paste, or use sugar of lead or nitrate of lead; any of these will answer the purpose as well, and stir into the first mixture while boiling. Color with ocher to match color of bricks, then add cold water, after which run it through a fine sieve, drain it through linen cloth—a bag is good—and when all the liquid has drained out, leaving the residue, take the latter and break into bits, and dry in the open air. When wanted for use it may be mixed with water like lime, to form a wash, and be applied with a brush.

In many cases bad stains might be painted out.

To clean hard-pressed bricks from water running over them and depositing iron rust, add 2 lbs. medium fine pumicestone powder to two quarts of soft soap and one-half pint of ammonia water, stir the whole and apply. Let it remain for 30 minutes, rub with a scrub brush, then sponge off with plenty of clear water. If this fails to remove all the stain then try oxalic acid 2 oz., butter of antimony 1 oz., dissolved in hot water, to which add, to form a paste, flour, and apply a stout coat of this, and after two days wash it off.

Stains from paint or oil remove with a paste made from 2 parts whiting, 1 part soft soap, and 1 part potash, with boiling water to form the paste. Apply heavy coats of this, and after a few hours remove same and clean bricks with soap and water, then wash off with clear water.

To remove white paint, make a solution of equal parts of sal soda and fresh lime, viz.: Dissolve soda in as little water as possible, then add lime and allow it to slake. The mass should be like soft butter, and if too thick, then thin it with water. After it has softened the paint wash off with hot water.

To prevent the burning out of the color of the paint by alkali in bricks or cement surface on brick wall, apply a size of 20 per cent. dilution of muriatic acid. Wash off with clear water, and let the bricks or cement become perfectly dry before paint is applied.

PAINTING CEMENT AND CONCRETE

Painting on Cement Work.—The difficulty of painting cement or stucco surfaces, or any surface containing free lime, arises from the action of the lime or alkali upon the oil of the paint. Remove the alkali and we have a surface much like an ordinary plaster wall. One of the earliest methods of overcoming this alkali was to neutralize it with an acid, diluted muriatic acid of about 8 per cent. strength, when mixed with water. The surface was thoroughly coated with this, after which all dirt, grease, or what not, was removed, and the work of the acid water helped in its action thereby. But, unfortunately, if the cement contains much lime, and this is commonly the case, the muriatic acid tends to neutralize the lime and convert into calcium chloride. This would prove most injurious to the cement surface; it would crumble and pit the surface; paint applied then to such a surface would have a very unstable foundation. Such a surface means disintegration of surface and paint.

When an acid, whether muriatic or sulphuric, is used as a wash on the cement surface an excess of acid is supposed to be washed off before the paint is applied. Yet in spite of this, the acid usually does injury to the surfaoe.

There is another method of treatment, wherein zinc sulphate in water forms the wash, and it gives better results than an acid, besides being much less costly. Taking equal parts by weight of water and zinc sulphate and mixing until the zinc sulphate is dissolved, it is applied with a stiff brush. It forms a fine coating that at the end of two or three days dries hard and firm. The caustic lime is changed to calcium or gypsum, while zinc oxide is deposited in the pores of the cement. Then when paint is applied it becomes incorporated with it, giving a lasting surface.

Still another process for neutralizing the lime and giving a safe painting surface on cement work, etc., consists in the application of a solution of 10 lbs. of carbonate of ammonia in 45 gallons of water. Insoluble calcium carbonate is formed on the surface, a large amount of ammonia being liberated. This is said to leave a perfect surface for paint. Where mortar used in stucco work contains lime it is better to apply two coats of this wash, made weaker, rather than one strong solution. In both processes given above, the surface is said to be uninjured by the treatment.

Linseed oil paints do well on a cement surface that has stood exposed to the weather for a year or so, for in that time the rain will usually have washed out the alkali. But it is not easy to determine just when this has actually occurred; there is always danger that the lime is there in some amount. Then, even after the surface has been treated with the chemicals we have mentioned, there is a possibility of the free lime from the inside of the surface working through.

How to Paint Concrete.—The following formula is given as being correct for painting cement.

The Priming Coat.—100 lbs. pure white lead, 4 gals. pure kettle boiled linseed oil (or in place thereof 9 gals. raw linseed oil and three half-pints of turpentine driers) and one gallon of turpentine.

The Body Coat.—100 lbs. pure white lead, 4 gals. pure linseed oil (1/3 boiled oil and 2/3 raw) or 4 gals. pure raw linseed oil and one pint of turpentine drier.

THE FINISHING COAT.—100 lbs. pure white lead, 3½ gals. pure linseed oil (1/3 boiled oil and 2/3 raw), or 3½ gals. pure raw linseed oil and one pint of turpentine drier), and one pint of pure gum turpentine.

Observe that the ingredients named are all of the best grade. Zinc white is too hard a pigment for the purpose. Some experts prefer red lead paint for the first coat, after this formula: 85 lbs. pure dry red lead, 1 gal. pure kettle boiled linseed oil, and 1 quart turpentine. Red lead will make a more impervious coating than white lead will, and it is also quite elastic, an important feature, but the objection to it consists in the possibility of its affecting light colors placed above it. The danger would be lessened, if not removed, by the use of a heavy bodied paint over it, followed by a good finishing coat. But even then there is danger of the red affecting the finish.

PIGMENTS SAFE WITH CEMENT.—For buff, yellow ocher; for light yellow, zinc yellow (zinc chromate); for red, red ocher or red oxide of iron; for blue, ultramarine blue (the sulphate ultramarine preferably); for green, ultramarine green or oxide of chromium green; for white, zinc oxide or zinc sulphide (lithopone); for black, mineral black, black oxide of manganese, black oxide of iron; for gray, graphite and lithopone, or lithopone and mineral black.

WATERPROOF CONCRETE PAINTS.—The committee on treatment of concrete surfaces of the National Association of Cement Users, has investigated a number of the so-called waterproof concrete paints and finds that they are much more efficient than colorless solutions.

These paints have been divided into two classes: First, those which give white, or light tints, or other colors pleasing to the eye and of a decorative nature; and, second, those which employ compounds of tar and asphalt which are necessarily black, or nearly so, and are, therefore, seldom used on exposed surfaces.

The presence of a finely-divided pigment serves to seal up the small pores in the surface of the concrete, leaving less work to be done by the vehicle.

In most cases the proportion of pigment used is small, and by using a cement color but little change in the surface appearance of the concrete need be made, unless desired, while on the other hand, almost any shade of color may be obtained. In this way the waterproof coating is made more serviceable and at the same time ornamental.

All these treatments are applied with a brush in the same manner as paint and are probably as durable on concrete as paint is on wood.

Concerning Creosote.—The creosote oil of commerce is known as "dead oil of coal tar." It consists of all oils known as the heavy oils, being residual oil, creosote, and pitch in solution. This creosote is what they use in preserving railroad ties, etc. In its crude shape it is not fit for staining wood, though some shingle stain makers simply thin it down with benzine or similar thinners. Such liquids injure the creosote for stain purposes, destroying its preservative qualities, and for this reason the benzine or other similar light oils must be regarded as dopes. On the other hand, the creosote will kill almost any color used with it unless it is reduced with considerable colorless thinners. It is so strong in its natural state that for almost any purpose it must be reduced or modified. If it has been thinned with benzine to the extent that this liquid may be detected by the odor then you may be sure that its preservative merits are gone.

There is a creosote derived from wood which is largely used in the manufacture of shingle stains and sold as creosote oil. It is a very light gravity oil of strong color and odor. This dark color is often imparted to the creosote by adding black japan to it, and if you can smell this japan reject the stain as a doped variety. Any adulteration that produces evaporation destroys the preservative value of the creosote.

The creosote shingle stain should be transparent in color, it should contain no water, it should contain no poisonous matter, and there is no need for using any poisonous pigment in its preparation as a shingle stain. Next to the preservative quality comes the matter of color. The two qualities combined produce a satisfying shingle stain. The siennas, the umbers and oxides, extremely finely ground, are especially adapted to the coloring of creosote stains. But the greens and the reds require special attention. The only greens of any use are the strictly pure chemical pigments. They are ground with an asbestos float of light gravity, which prevents the pigment from sinking. The colors are ground fine enough to float well throughout the mix, insuring good color-cover power, rendering stirring practically unnecessary. The reds, apart from the oxide red, are subject to the same treatment as the greens. They should be chemically pure pigments or mineral color, and not aniline, as aniline colors will fade in the sun.

Pigments used for shingle staining should not only be pure and of the best grade, but they must be transparent also. Such pigments as umber, sienna, chrome green, chrome yellow, Prussian blue, and drop black are useful pigments; they may be used alone or in combinations, according to the color desired. Zinc white is useful where a white is desired, as it is non-poisonous. If poisonous colors are to be barred, then we must drop out chrome green, chrome yellow, and lead pigment. This will not be necessary excepting where the water from the roof is to be used for certain household purposes. It should also be said that as creosote contains more or less sulphur compounds in solution, by coming in contact with pigments that contain metallic bases, they will change the color to darker or muddy shades. The dark creosotes may be used for the dark colors, while the refined creosote oils may be used with the light colors, such as yellow, gray, etc. The light refined oil has been cleansed from nearly all its sulphur compounds, giving an oil that is almost inert to all pigments.

Creosote stain will become more or less thick in cold weather, due to the naphthaline always found in it; in this condition, if wanted for use, heat it slightly; keep it in a place having a temperature above 40 degrees Fahr.

Before dipping shingles in creosote stain, or when brushing it on, first rub some linseed oil on the hands, wrists and face, to prevent the action of the stain, which produces a burning sensation when it comes in contact with the flesh. If this precaution has not been taken, and should some of the creosote have splashed on your flesh, do not try to rub it off with a cloth, which would only spread it, but rub with linseed oil, then wipe it dry. Nor try washing the creosote off, as that would simply increase the discomfort by washing out the tar acids, of which true creosote contains about ten per cent.

Cheap Creosote Stain.—The doped creosote stain is not advised, though it is often used. To cheapen the creosote add three gallons of water-white 150 degree test petroleum oil and one gallon of japan drier to three gallons of the creosote oil. Crude oil, kerosene, benzine, and other mineral oils do not unite with creosote, although such liquids are often used in doping creosote oil.

How to Stain Shingles.—To secure the best results in shingle staining use the true creosote stains, see that the shingles are perfectly dry, and if it should be necessary to thin out the stain use raw linseed oil for exterior stains, and turpentine for interior staining. But such thinning is very seldom required, as the stain is made sufficiently thin for use, and unless long exposed to the air will not evaporate. If the shingles are in bundles when you arrive to do the staining, open them out and give them time for drying before staining.

If the stain is too thin it will fade out and have a washed-out appearance. The stain that will dry hard over metal may well be suspected of being doped with kerosene oil. The painter is apt to thin up with this. The pure creosote shingle stain contains more raw linseed oil than paint does, hence it needs plenty of air to make it dry right; this will apply particularly to inside staining.

Interior creosote stains should have at least 24 hours for drying before varnishing. These stains are not so permanent as the exterior stains, because they are mixed with turpentine very largely, yet they are by no means fugitive; it is claimed for them that they will stand direct sunlight for as many as six years.

Dipping Shingles.—This is the best way; dip them about two-thirds their length in the stain, and this insures stain on all visible parts after being put on the roof. Then a brush-coat after they are laid will make a very fine and lasting job. Open the barrel of stain by removing the head, then tack a narrow strip of wood across the top, near the edge where you are to stand; dip in the shingle and draw it across the strip to remove surplus stain; then throw it aside, where the shingles will form a loose pile, admitting free passage of the air. Stir the stain in the barrel often.

As creosote is a good wood-preservative, this dipping of the shingles insures perfect coating of the wood as far as it goes, and this means all parts that can possibly become exposed to the weather; it also greatly assists in keeping the shingles from warping, the shingles being properly nailed down by the carpenters. The advantage of a brush-coat, or staining after laying, in addition to the dipping, consists in the fact that any raw parts of the shingle made by cutting around corners, etc., will be coated with the stain.

Artistic Staining.—When it is desired to have more than one color on a roof, use as few as possible, as this gives a more pleasing effect than where several colors are used, and, if possible, do the entire job in one color. The greenish shades, such as the olives, please the general public taste better than the other shades, probably because they harmonize more perfectly with nature. Avoid a reddish-brown or a pronounced yellow, or even a strong yellowish-brown with a green roof. In fact, a greenish roof should be combined with a cool gray, and it cannot be effected by using Prussian blue. A beautiful effect may be gained by taking a pail of quite thin red and one of quite thin green, and with one brush put on the colors alternately, so as to give the varnishing effect of green and red, as seen upon autumn leaves. With this for the sides, a green roof may be used, the effect of the sides, at a distance, being grayish, and not red and green.

When a roof is to be painted or colored in any way, its use and location should be considered. A low roof, or roof of a low building, should be of a lighter color than that of a high and more imposing building. Light colors make a cooler roof, but they are more objectionable to the eye than darker colors, especially where sure to meet the eye frequently. The surroundings of a building are to be taken into consideration also. A rural dwelling that is surrounded by trees or shrubbery should have bright colors, such as red and ocher, which look very charming when viewed through the dark green leafage. The roof is a very salient part of a building's architectural features, and should receive artistic and skillful treatment. A badly painted roof may spoil the entire appearance of the best painted house.

One gallon of creosote stain will cover 100 square feet of shingles, two coats. When dipped, 2½ to 3 gallons will cover 1,000 of the regulation 4 x 16-inch shingles. A lighter colored stain than the shade really desired should be applied to old shingles and, in order to obtain the best results, two or even three coats should be applied.

Painting Shingle Roofs.—Let it be of a good mineral pigment mixed with pure linseed oil only, with a little japan driers. Mix it quite thin—a mere priming coat—and the damming of the cracks will be greatly lessened, if not entirely avoided. It is best to use pigments that are ground in oil, for the dry pigment is too coarse for this purpose. Nor should a ready mixed paint be used, for it will likely be unfitted for this particular purpose. After mixing the paint, strain it through a fine sieve, which will remove any foreign particles and make the mass more perfectly incorporated. To mix it, add a little oil to the pigment at first, and work it into a smooth paste, gradually adding more oil until the mass is quite soft, and then it may be further thinned for application. The use of driers should be carefully done, as excess of this liquid will tend to injure the paint, so that it will not wear as well. Paint on shingles is in a position to suffer a great deal more from the weather and sun than when used on the sides of houses. Therefore, see that it is of the best quality and carefully mixed. Many times it will not require any driers, as in summer, in dry weather.

Shingles may be dipped in paint just as with shingle stain, by making the paint very thin, and adding some benzine to the mixture, which will thin out the paint and make it more penetrative, while not affecting the paint, as it evaporates and leaves the oil as it was. Place the thin paint in a tub or half barrel, and tack a strip across, and as you dip the shingle draw it against the strip, which will remove the excess of paint.

PAINTING WITH RED LEAD PAINT

We painters usually regard red lead as a pigment to be avoided in painting, and find very little use for it. It is difficult to handle, and many painters do not know how to. Made from the metal lead, from whence comes white lead, why is it so different? Red lead is pure metallic lead plus oxygen. White lead is pure metallic lead plus carbonic acid gas. Take either red or white lead and apply sufficient heat to them and they return to the pure metallic lead form, plus some ash. When the lead metal is heated in a furnace and air is allowed to pass freely over its molten mass it oxidizes, forming litharge. Further heating produces red lead or orange mineral, the two similar yet distinct; orange mineral is very similar to red lead but does not take the place of red lead in painting.

There are several kinds of red lead on the market, nearly all of them pure lead pigments, but their value as painting pigments varies greatly within wide limits. Chemically, red lead is a mixture of litharge and red lead. It is the litharge that causes the red lead to set so hard in the paint pot after mixing with oil and allowed to stand some hours. Broadly speaking, the more litharge a red lead contains the heavier it is, the less covering power it has, pound for pound, and the more it tends to settle after being mixed. Government specifications call for a red lead containing at least 94 per cent. red lead, and this is true also of many of the railroads. This insures the maximum bulkiness and fineness. They also specify that the red lead must be mixed on the spot, when wanted for use, in pure, raw, well settled linseed oil, and without driers. Such a paint will dry by oxidation on the surface to which it is applied, in a cement-like film, that admits of no pores through which moisture may infiltrate. First they see that the surface to which the paint is to be applied is made perfectly free from scale, and clean.

A ready-mixed red lead paint cannot be a pure paint, for the reason that it would become too hard in the container to be useful. Hence such paint is mixed with such substances as China clay, silica, or similar inert materials, which tend to prevent hardening. Whiting and barytes also are used in this way, but such compounds have no more value than iron oxide paint, which merely affords a loose, porous film, quite unlike a red lead paint film. Some of the ready-mixed red leads contain soap, paraffin, wax, asbestine or graphite, which keeps the red lead in suspension. The only way to do in order to have a perfect coating is to mix the dry red lead and oil on the operation, day by day.

Excepting in special cases, and which are given in this connection, no driers should be added to red lead paint, for it will dry easily with raw linseed oil. Driers decompose the oil.

A peculiarity of red lead paint is that it will assist in drying the paint coating over it. If you prime or first-coat with red lead and place a white lead coat above it, the latter will be assisted in drying by the influence of the red lead beneath it. Hence very little, if any, driers need be added to the latter coating.

After drying, red lead paint remains elastic, a very important feature, particularly as regards metal, for it allows of expansion and contraction without allowing the paint to crack in any degree. It also hardens without shriveling, even where applied in heavy coats, and forms the toughest and most perfect insoluble combination of all forms of protective paints. It imparts no oxygen to iron, even when exposed constantly to dampness.

Red lead should be very finely ground, for then it has less tendency to settle in the pot. Some red leads are coarse and crystalline, and so unfitted for paint. Examine under a microscope and compare with a standard good grade. If the red lead is pure and very fine, it is just as good when mixed dry with oil as it could possibly be with grinding in oil. Mix only what is required for immediate or daily use.

It is advised by some to mix up red lead for next day's use by adding about three-quarters of the oil necessary to its proper mixing, forming a stiff paste, which will give a more perfect admixture of pigment and oil. Next morning, when ready to use it, add the balance of the oil to form a suitable paint, stirring in the oil thoroughly and keeping the mix well stirred in the pot while using. Clean out the paint pot at quitting time, allowing none of the paint to remain, as it would become like cement in the pot if left there. If not kept continually stirred while in use the oil will, by settling to the top, be used up first, and the work will show less and less of the lead until the oil is used up. Mix thin, and brush it out well; allow one coat to become perfectly dry before applying the next coat.

A satisfactory thinning of red lead paint may be had by mixing at the rate of 33 pounds of the lead to one gallon of raw oil and one quart of turpentine, and if not thin enough add a little more oil. As a rule turpentine should not be used with red lead, but is sometimes used when the weather is damp or very cold, as it then facilitates the spreading of the paint.

While plenty of oil is advised in mixing red lead, the rule has some exceptions. If we can get heavy red lead paint on, rubbing it out well and having the least amount of oil in it, it will be more wear-resisting than a very oily red lead paint. But painters object to the difficulty of spreading heavy red lead paint, and for this reason they will thin it out too much. This causes the paint to sag or run. Dried, uncombined linseed oil, whether raw or boiled, is an absorbent of water, and hence the more red lead and the less oil the better it will protect metal. Raw oil may be used in summer, and boiled oil in winter.

The use of dry red lead is one of the very few exceptions to the rule that a dry pigment mixed with boiled oil should never be used as a primer.

It is held by some that red lead paint mixed with raw oil will not harden without the assistance of some driers, and when applied to iron will not prevent rusting. This is true where the oil contains some non-drying or non-saponifying oils, as adulterants, or if the red lead is adulterated with iron ore or red stained barytes (neutral), since these pigments cannot assist in the drying of the oil. But it is well known that no paint hardened by driers can be waterproof. The drier, being a liquid, unites with the oil acids before the slower acting dry basic pigment can combine with it, leaving behind the neutral fats of the linseed oil, which have little or no chemical affinity for basic pigments, and the paint remains a conveyor of water, and so the iron is attacked and destroyed by rust.

It is generally the custom to use boiled oil with red lead for painting iron structural work, but this is a mistake, for the reason that boiled oil being neutral does not saponify sufficiently to prevent free red lead and uncombined oil in the paint, and the result of this is that the free oil must oxidize by absorption from the air; this oxidized oil finally becomes brittle and perishes. Paint thus prepared is not waterproof, and hence cannot protect the iron.

Red lead is especially valuable for painting wrought iron. Cast iron is rough and will hold any sort of paint, but the wrought iron is smooth and needs a tough, elastic paint which will hold of itself, no matter what the condition of things beneath it. This, red lead paint does; but care must be taken not to make the coating too thick or heavy, especially when boiled oil is used, as this would cause wrinkling, besides making a surface that would likely crack superincumbent coats of paint.

Preventing Settling.—There are ways to prevent the settling of red lead in the pot, and while the materials employed for this purpose injure the protective qualities of the paint more or less, yet in some cases it will not be found very objectionable. Thus, by mixing the dry red lead to a pulp with water, then adding the oil, stirring it in vigorously to incorporate it with the water and lead, the lead will hang in the oil for hours without settling. The water will then dry out after the paint has been applied, and possibly leaving the lead and oil more intimately mixed than it would have been without the water.

Another way is to add whiting, which will also prevent sagging. Sagging is a fault of red lead that is too heavy, and on a very close or hard surface. The whiting does not seem to affect the wearing of the paint appreciably, but of course too much of it must not be used. It does not alter the color of the paint unless used in excess. You may add as much as one-half or even three-fourths whiting. It makes the paint work easier, holds it in suspension, prevents sagging, and some say it adds to the elasticity of the coating, though this may well be doubted. Such a paint will adhere to metal well, and its color may be modified with lampblack.

The addition of lampblack seems to improve red lead paint, not only in giving it a more agreeable color, but by making it more elastic and durable, and some think it keeps the lead in suspension to some extent. The addition of one-sixteenth of an ounce of lampblack to the pound of red lead will give a pleasing chocolate brown. It is not advised to add more lampblack than this if the best results are desired with the paint. And when lampblack is used with red lead there should be a larger proportion of oil than when the red lead is mixed alone in oil, as lampblack takes up more oil than red lead does.

The iron surface that is to be painted should be made clean by scraping and dusting off, and the first coat may be mixed from dry red lead and raw oil three-fourths, and turpentine one-fourth, or turpentine may be omitted and oil increased to that amount. The second coat may contain some turpentine, but the third and last coat should consist only of raw linseed oil. A job done in this way will retain a bright surface for a long time.

To ascertain the cost of a red lead paint made according to the formula I have given, estimate the 33 pounds of red lead, dry, as seven-sixteenths of a gallon increase over the amount of liquid used in thinning the red lead. One gallon of this paint will cover approximately 800 square feet of plain painting on average metal surface.

The following will show the results obtained when different proportions of lampblack are used:

20	lbs.	red lead	1. gallon of paint and covers
5½	lbs.	raw oil	1200 sq. ft. ratio, 1/16 oz.
1¼	oz.	lampblack	lampblack to lb. red lead.
14	lbs.	red lead	1. gallon of paint and covers
6	lbs.	raw oil	1200 sq. ft. ratio, ¼ oz.
7	oz.	lampblack	lampblack to lb. red lead.
10	lbs.	red lead	1. gallon of paint and covers
6¼	lbs.	raw oil	1620 sq. ft. ratio, 1 oz.
10	oz.	lampblack	lampblack to lb. red lead.

In blendings of lampblack and red lead the use of boiled or raw oil with japan is desirable. Says the president of one of the best-known lead oxidizing companies:

"Red lead and lampblack dry very slowly in raw oil, less slowly than when japan is introduced, and in boiled oil dry more quickly, the drying property varying with the quantity of lampblack used—the more lampblack the more slowly the paint dries. So in a mixture of red lead, lampblack, raw oil and japan or boiled oil the amount of japan necessary will vary with the amount of lampblack used. We wish to say, however, that japan or boiled oil are employed not so much for their drying properties as they are for the purpose of a binder to prevent the red lead, lampblack and oil separating from each other, which is occasioned on account of the red lead being so much heavier."

In about the proportions of the preceding tables, "mixtures of red lead, lampblack and raw oil dry in from 16 to 24 hours, the mixture containing the most lampblack being the longest in drying. Red lead, raw oil, lampblack and boiled oil, about 12 hours." These results will vary with the weather, etc.

Red Lead Paint Formulas.—To 100 lbs. dry red lead add four to five gallons of raw linseed oil, one quart of turpentine japan, and one quart of good varnish.

To 100 lbs. of dry red lead add four gallons of raw linseed oil, one quart of turpentine, and one-half pint of japan for slow drying, or one pint for quick work. This formula was used in a ship yard.

To 100 lbs. of dry red lead add four gallons of raw linseed oil, for summer, and boiled oil for winter, one gallon of turpentine and one-half gallon of japan, a formula used by a large railroad company.

One railroad company adds lampblack to the red lead at the rate of ten ounces to 12 lbs. red lead; this is thinned with raw oil to make one gallon of paint.

A certain firm give this as their formula: Mixing the paint as given in the first formula, for the first coat they use 11 lbs. of red lead to the quart of oil; this is allowed to stand a while, when it is thinned with a mixture of one pint of raw oil and one-quarter pint of japan. This makes a half gallon of mixed paint. For the second coat take 10 lbs. of red lead, three ounces of lampblack, and one quart of oil; thin with one pint of oil and a quarter-pint of japan.

Red lead paint may be made by thinning 25 lbs. of dry red lead with one gallon of raw linseed oil, mixing thoroughly and then straining it. Add a gill of good drying japan. This will make a gallon and a half of paint; ordinarily it will cover 700 square feet of iron surface, one coat.

A certain railroad company uses 21 lbs. of red lead to the gallon of oil. A New York bridge concern specifies the ratio of 3½ of red lead to one of oil by weight. A large railroad city station was painted, the ironwork, with a paint that was made with red lead 20 lbs. to the gallon of oil.

PAINTING TIN AND OTHER METAL ROOFS

The New Tin Roof.—New tin roofing is coated more or less with palm oil, which is a non-drying oil. Remove this oil before applying paint. This may be done with benzine and cotton waste, or with sal soda water. The former is best but costliest; the latter is cheapest and is efficient, its only fault being that it leaves the tin wet, and this soon evaporates. Still, a cheaper way is to let the roof be for a few weeks, or until rain and shine have acted upon it. But all the oil may not disappear in this way, and then rust may develop, and the rust will have to be removed or it will continue under the paint. Then there will be traces of the rosin that the tinner used in laying the roof; this must be scraped off and the roof be swept clean with a broom.

The way to make and apply the sal soda solution is to take about one pound of soda and dissolve it in a half-bucket of hot water.

Do not apply paint to the roof until it is clean and dry; select a fair day for it, when the weather is moderate, neither hot nor cold. The fall is, in many sections, the ideal time of year. While some advise allowing a new tin roof to stand to the weather for some time before painting it, even to the extent of allowing some rusting, yet it cannot be advised here as good practice. Soon as the roof is fitted for it apply the paint. One coat only, and that light; never heavy paint on tin roofs. In another year a second coat may be found desirable. Some experts apply two coats on the new tin, and a third a year later. The under side of the tin is painted by the tinner, and while there is no doubt that good paint should be used there, as a matter of fact it never is. The best pigments for tin roofing are the iron oxides, such as metallic brown and Venetian red. Mix with pure raw linseed oil only, with a very little driers, unless in warm, dry weather, when no driers will be needed; they would injure the paint. No paint containing tar, pitch or bituminous compounds, nor graphite, should be used. Lead and zinc paints are also taboo. Red lead is used by some painters for the first coating, after which an iron oxide paint is applied. The red lead is to be mixed with raw oil only, and no driers. But there does not appear to be any decided advantage gained by the use of the red lead.

Use ordinary paint brushes for painting tin roofs, and not the long-handled brush. Rub the paint into all exposed parts of the tin, and do not rub out too thin; let it have a fair coating. Avoid runs of paint along the seams and edges.

A gallon of average oxide roofing paint will cover about 500 square feet of surface, the paint not to be mixed thick. About equal parts by weight of oil and pigment should be used; that will be about 7½ lbs. of dry pigment and one gallon of oil. Or if paste pigment is used, then mix 25 lbs. of the pigment with 2½ gallons of oil.

The Old Tin Roof.—Before repainting the tin should be scraped and made clean. The paint may be rather thinner than for a new roof, because of the old paint on it. Rub it in well, and lay it off smooth and level. Use the same kind of paint as directed for new tin roofing.

Old Gutters, Rain Spouts, Etc.—While it may be necessary to use fresh paint on such work, yet it is often feasible to utilize old paint skins, etc., in such work. If you have a lot of odds and ends of paints and colors you can place them in an iron pot and add some linseed oil and boil all together until the mass becomes like thick paint. Thin up if necessary, then strain and add sand until you have a workable paint. Apply hot, or at least warm. Give it a heavy coating. It may be used around flashings, chimneys, on old gutters, etc.

The inside of a rain spout is seldom or never painted, yet it is just as subject to rusting as the outside surface. Pipes may be painted on the inside before they are put up by pouring some paint into them and turning them around until the paint has reached all parts of the surface. If the pipe is up, then the inside may be done with a swab of rag waste or sponge, filled with paint and drawn up and down by a string tied to it, one string to draw it up with and another to pull it down; it will of course require two men to do the trick.

Painting Copper Roofing.—The only copper roof that the painter will likely be called upon to paint will be some dome, where it is desired to cover it with gold leaf. A full description of this work is given in the "Expert Sign Painter," which see. Briefly it may be said that in order to paint copper the surface must first be treated with a solution of bluestone and a little nitric acid, which will slightly roughen the surface and give tooth for holding the paint. Some use a mixture of one part acetone and two parts benzol, which is in fact a sort of paint remover. Let it dry, then apply the paint. A painter says it will hold.

Painting Zinc Roofing.—Zinc and galvanized iron roofing are the same as regards treatment necessary to prepare it for painting. The greasy surface, as we call it, meaning the peculiar nature of the zinc or galvanizing, may be cut with the following mixture:

To a gallon of water add two ounces each of copper chloride, copper nitrate, and sal ammoniac; pulverize and stir into the water. Then add two ounces of muriatic acid, and stir until the chemicals are all dissolved. Apply this wash with a whitewash brush, and let it dry. The color at first will be black, but it soon changes to gray. Mix the chemicals in an earthen vessel. See further concerning this subject under another head.

Colors for Galvanized Iron Roofs.—Though white roofs are objectionable in appearance, they are cool. Green and red may be more pleasing; they cannot be as cool as white. It is a question whether comfort is to be sacrificed for appearance. Refrigerating paints are sometimes supplied in tints of green and terra cotta, which are claimed to possess all the merits of white refrigerating paint. In some parts graphite paint is used for galvanized iron roofs; in other localities red lead is used. Both are considered good rust-resisters. The chief aim, however, of good roof paints, is to lessen the temperature. It is questionable whether any dark color is as successful for this purpose as white. It is generally known that white reflects both light and heat, while dark colors absorb these, which explains why white is more effective as a cooling medium than dark colors.

On galvanized iron the best adhering paints were found to be red lead, burnt umber and sienna, Indian red, Prussian blue, lampblack and graphite, while the poorest adhesives were zinc oxide, lithopone, clay, silica, etc.

PAINTING AND BRONZING RADIATORS

Steam and hot water radiators require to be lacquered with varnishes of special quality, owing to the high temperature to which they are exposed, this being near the boiling point of water. Oil paints are unsuitable, being liable to blister, whilst colors turn brown and peel off. The best lacquer is a good asphalt varnish, which, when baked, will keep its gloss and last a long time; but black is not a favorite for this purpose. The same material can, however, be used in the preparation of red-brown, dark brown, and gray shades, by adding Venetian red and lithopone respectively to the asphalt varnish.

To obtain a durable coating of all paint topped with varnish, the former must be well thinned with turpentine, so that it dries matte, another coating then being given and varnished with special varnish. Some commercial varnishes sold for this purpose soften under the influence of heat, and in a very short time become brittle and rub off under the finger. The varnishes should be made of copal, inferior grades being prepared from hardened resin or colophony, and should be thinned in order that they may harden quickly and not turn brown. Thicker varnish can only be used when a baking oven is employed, the coating then being very durable, and of good appearance.

Black Radiator Varnish.—(1) Prime Syrian asphaltum or Gilsonite, 10 parts, are heated over a moderate fire with 2 parts of linseed oil until uniformly fluid, and the mixture is thinned down to the consistency of varnish with turpentine when cool. (2) Asphaltum, 6 parts; Lignite asphaltum, 4 parts; and linseed varnish, 2 parts, are melted together, and thinned down, when cold, with turpentine and benzol or heavy benzine.

Bronzing Steam Pipes and Radiators.—For gold bronze powder, paint the pipes with medium chrome yellow, and when this has become nearly dry rub on the gold bronze, using a piece of fur or a brush. When perfectly dry apply a coat of thin copal or mastic varnish.

Oxidizing a Radiator.—Paint the radiator a dull yellow, and when dry lightly sandpaper smooth, then apply a thin coat of color, a mere glaze, and of whatever color you may fancy, and rub out to simulate the oxidizing.

Painting the Logs of Gas Radiators in Imitation of Wood.—These logs are usually bronzed with copper bronze or green bronze, and then blended in with colors, so as to imitate the bark of certain trees. To give certain effects, such as the bark of birch or maple shows, asbestos fiber is attached in certain spots.

The colors used, or rather, the pigments employed, must be resistant to heat, as, for instance, umber, raw or burnt, Indian red, mineral brown, oxide of chromium green or copper green. The paint must be made with a medium or binder of silicate of soda, because there is no medium containing oil or gums that will be able to stand such degrees of temperature as are required here.

Bronzing Solution.—Reduce a good varnish with turpentine to the condition of a bronzing size, being careful not to get it too thin, coat the surface with this and dust aluminum bronze on; this is the best way. To mix the bronze with the size, to be painted on, use equal parts of varnish and thinners.

Painting Radiator White.—It is difficult to get a white job that will remain white, for the paint will be more or less affected. It is found best to use what is called a white varnish, or very light copal made of hard gum, to withstand the heat. Make the preparatory coats white and flat, sandpaper smooth, or at least rub off any roughness you can, then apply the white enamel varnish. Use red seal French zinc white with turpentine for the flat coats, and then two coats of white copal varnish. Lithopone is said to do well on white radiators.

The factory formula as given by Scott, is as follows:

Common zinc oxide	22 lbs.
Barytes	10 lbs.
Pulverized soapstone	3 lbs.
Grind in	
Japan gold size	½ gal.
Turpentine	¼ gal.
Carbon tetrachloride	¼ gal.

This paint dries very flat, and is not much discolored by heat. If preferred it may be ground in the celluloid mixture, in which case there will be no discoloration whatever. This solution is made as follows:

Four ounces soluble gun-cotton, dissolved in 32 fluid ounces amyl acetate. Let stand ten hours, then add 32 fluid ounces amyl acetate. Finally add the following solution: 1 ounce gum camphor, dissolved in 8 fluid ounces acetone.

This solution must be thinned with amyl acetate, when thinning is necessary, as benzine or turpentine will cause the gun-cotton to precipitate its original cotton. Try to get in touch with a dealer who handles such paint as radiator white.

Oil paint will not answer for radiators. Use instead a color ground in japan, thin with good baking varnish, and do not make the paint too heavy or thick.

Painting Radiators.—Clean all greasy spots with benzine. When the iron is clean take any good bronzing liquid and stir enough aluminum into it to make a paint that can be easily spread with a camel's-hair brush. Apply one or more coats, as the case may require. If you prefer to make your own bronzing liquid take equal parts of gold size japan and light-colored baking varnish and mix them well. To each liquid ounce of this mixture add three liquid ounces of turpentine. Shake well in a bottle and it is ready for use. If the aluminum paint doesn't give you sufficient luster, apply a coat of baking varnish to your radiators, and when it gets tacky dust the dry bronze on with a camel's-hair brush or tuft of cotton, spreading a large sheet of paper on the floor under the radiator to catch the surplus bronze, which can be used again.

PAINTING STRUCTURAL STEEL WORK

It formerly was the custom to give structural steel work a protective coat of paint before it left the shop. But some architects and engineers questioned the wisdom of this practice, believing that better results would follow by sending the material out without paint. In the first place a certain amount of weathering removes the mill scale; then the shop coating was usually done by inexperienced labor, and what they did was so poorly done that it were better to let the naked metal take the weather.

Where no paint has been applied at the factory the priming coat should be applied just before assembling. The surface of the work should be thoroughly cleaned and should be free from any rust. If the air is dry and warm the work will be better than when done in a moist air and when the air is cold or raw. A thick, hard, elastic film of paint should be applied. The paint should be well brushed out, more so indeed than paint on wood. The more the paint is worked under the brush into the iron, the better it will hold. A thick film of paint will be more impervious to moisture, and the more pigment the paint contains the greater its waterproofing qualities. Linseed oil alone will afford no protection from moisture, or at least little and that only temporary. It forms too thin a film, for one thing, and then linseed oil is not waterproof. But mixed with red lead the compound gives an almost ideal coating. Such paint is hard, yet elastic; thick and adhesive; the pigment fills the pores in the oil film. It is possible to mix as much as 33 lbs. of red lead with a gallon of linseed oil and get good working qualities and a paint containing the maximum amount of pigment.

Red lead is an inhibitor of rust, a preventive, and combined with linseed oil it forms the hardest elastic paint film we know of; water will not penetrate it; in fact, the marine underwriters formerly demanded an extra premium for policies written to cover steel ships whose hulls were not so painted below the water line. All the ships of our navy are so protected, as well as those of foreign powers. The huge steel members of the locks on the Panama Canal are likewise so protected. In fact, practically all structural steel is protected with red lead, both that belonging to the government and that erected by corporations or private individuals. Engineers and chemists agree that all steel structures should have at least two coats of red lead and linseed oil, followed by one or more finishing coats for decorative purposes. These coats should all be of a different shade so that the inspector can readily detect faulty work. No paint will protect steel unless it is honestly applied, and a little lampblack added to the red lead after the first coat will produce the necessary variations in the shade, as well as aid in securing a uniform thickness of film, and consequently uniformity of expansion and construction.

There are some rules that might well be observed in connection with the surface on which the protective paint is to be applied:

(1) The surface should be perfectly clean and free from moisture, greasy matter, rust and mill scale. No pains should be spared to insure a perfectly clean, dry, metallic surface.

(2) All minute holes, cracks, fissures between plates, poles and the like, should be filled with a suitable "filling" or "stopping" before painting is pro-

ceeded with. The condition of "metal-to-metal" is particularly objectionable, as local galvanic action is thereby excited, and this excites corrosion. A protective paint film to be effective must be continuous for the whole surface, and this result cannot be secured unless the said surface is made perfectly solid and continuous.

But paint will not prevent iron rust. The iron will rust beneath it, because the oxygen of the air will gain access to it sooner or later, and this, of course, causes oxidation of the iron. It seems, indeed, durable and useful as it is, that the purpose of iron, considered in itself, is to decay. Rust will continue even under paint, until the entire structure has become a mass of rust. Treated chemically or otherwise when being made, a surface can, possibly, be made that will prevent oxidation. Indeed, there is a non-rusting iron, I believe, but it is not practical for general use. White lead, which is carbonate of lead, and at one stage of its manufacture an oxide, is one of the very worst pigments to apply to iron. Zinc oxide also is bad, and will eat into iron. The marking compound used at the iron mills is not white lead, but a very cheap mixture composed mainly of whiting or barytes and oil, driers and benzine. There is no lead in it, lead being too costly. As to what constitutes the best paint for coating iron or steel red lead is generally preferred to any other form of paint.

Painting Iron Bridges for Railroads.—All the iron ore paints contain phosphorus and sulphur, unless the ore has been burned to eliminate those properties; and either sulphur or phosphorus is inimical to iron. Asphaltum paints are usually well supplied with benzine or some other volatile product, which soon evaporates after it has been spread upon the iron, and leaves a rough surface upon which soot and sulphur from the burning coal in the locomotives accumulate, and with setting of fog and dew upon the iron, produces an acid which, by contact with the iron, causes oxidation on the surface of the metal, which causes serious injury to the structure, and very soon requires a thorough cleaning and repainting. Many of the cheaper paints are of a thick, syrupy nature, and require a large mixture of naphtha, benzine or turpentine to make them spread readily. These paints are of short duration, and require such frequent renewals that they become expensive.

I think, on the whole, that pure linseed oil and lead, properly put on, and colored so as not to draw or absorb from the sun's rays, make the most lasting paint, and give the best protection to the iron. In my judgment, all iron in bridges should be coated with boiled linseed oil. In warm weather this can readily be put on so as to cover the inequalities of surface; and when two or more places are to be riveted together, each surface should receive a coat of paint carefully applied in the shops where the work is being done. Then, when the structure is erected, it should receive two coats of lead and oil paint of some light gray or stone color. And before painting, all places where rust has taken place should be thoroughly cleaned before painting. Experience shows that bridges cared for in this manner have given better results and are really more economical in time than those painted with other than lead and oil paints.—*G. M. Reil.*

Footnotes on Iron Painting

Once it was thought that iron oxide paint was the best for ironwork; red lead is now favored as best.

Elasticity is necessary to the durability of paint on iron, and red lead and linseed oil insure this.

Red lead requires only from three to four gallons of oil to bring it to a painting consistency, where dry iron oxide will require 15 gallons of oil.

Some engineers think the best first and second coating for iron or steel work is a mixture of two parts red lead to one part white lead.

Old painted ironwork should have all rust and scale removed before repainting; it may be burned off, after which apply a coat of turpentine or benzine.

Lampblack and graphite are often used with red lead and oil, not necessarily to improve the lasting qualities of the paint, but to make the paint work smoothly and evenly, also to improve the appearance.

For painting on iron, to 25 lbs. of red lead, dry, add one gallon of oil. Stir the oil in gradually, then strain it. Unless a very quick job is desired, no driers will be required, as red lead itself is a drier. If driers are used, add a gill to the above formula. This will make a little over a gallon of paint, which should cover about 1,000 feet of average surface.

An expert says that years of experience have shown him that the best primer for new iron or steel work is raw linseed oil. If there is rust on the iron, the oil will absorb the oxygen contained in the rust and will convert the whole mass into paint.

Another expert advises oil priming, but goes about the work differently. He first cleans the iron, then goes over it with a steel brush dipped in hot linseed oil, and when this coating has dried sticky he applies a coat of paint. He says that "objects thus coated will preserve the paint from heat and cold, dryness or moisture, for an indefinite period."

PAINTING GALVANIZED IRON

New galvanized iron will not take and hold ordinary paint unless previously treated with chemicals. Not knowing this fact has caused much loss and vexation. By allowing the metal to stand to the weather for some time, a year at least, it will then take paint very well. The zinc coating seems slippery or greasy, as some call it, and this feature must be removed before painting. The best chemical treatment is as follows: Take 2 oz. each of copper chloride, copper nitrate, and sal ammoniac. Mix with water 1 gallon in a glass or earthen vessel. Apply a coat of this with a broad bristle brush; when dry it will be black, but this will soon change to a grayish color. One gallon will cover about 25 to 30 squares of 100 feet each. It is easily made and inexpensive. Another way, preferred by some, as it is easier to prepare, consists in applying a coat of copper acetate wash. To one gallon of water add 6 oz. copper acetate. This will give to the work a coating of black copper oxide. Paint will adhere to it. The Government specifies for the purpose simply strong vinegar. You would do well to test this. The railway companies do considerable painting of galvanized iron, and some of their master painters first wash off with gasoline or benzine, to remove the grease, then apply a coat of coach finishing varnish. On top of this any desired paint is applied. Some add a pint of good finishing varnish to each coat of paint applied over the varnish first-coat. Another master painter says he washes off with benzine, then applies a coat of mineral paint, thin and well brushed out. This paint is thinned with boiled oil. He adds that he has never known paint to scale from galvanized iron when done this way.

The master painter of a ferry boat and railroad company tells us that he has tried vinegar, sulphuric acid, ammonia, muriatic acid, and a mixture of acids and chemical salts, and the results given have been fair but not uniform; there was much peeling of the paint after these treatments, as without them. With all due care he says he never has been successful in preventing more or less peeling of the paint. He thinks that the dipping process followed in the galvanizing of objects, involving ammonia and palm oil, renders the surface unable to take and hold paint, no matter how treated before painting. How the doctors disagree! Another master painter says that he did a job of painting on galvanized iron 25 years previously and that the paint was still intact; he primed it with French yellow ocher and followed with two coats of English white lead, sandpapering each coat but the last.

A paint chemist tells me that sponging the surface with white wine vinegar and following with a coat of spar varnish thinned with turpentine is effective. On this apply any desired paint. The first coat of paint over the varnish primer should be made rather flat with turpentine.

Some technical writer says that the scaling of paint from galvanized iron is caused by electricity, and that the white powder found beneath the paint is zinc oxide, the result of electricity. Thus various reasons are given for the failure of galvanized iron to take and hold paint. One very plausible reason is that the use of sal ammoniac in the galvanizing process causes the formation of a thin film of the basic chloride of zinc on the surface of the metal being galvanized, which substance, being of hydroscopic nature, acts as a repellent to prevent the close adherence of the paint to the metal, and the pigment dries as a skin over it.

Formerly architects specified that galvanized iron should have three coats of paint, the second and third coats to be sandpapered. This was too much paint, and it caused scaling. The fewer the coats the better, and each coat should be well rubbed out. The paint should be thin. Just enough paint to hide the surface is the rule. Of course much will depend upon the first coat, whether it is hard or elastic. But too much paint over any primer is not safe. White lead and zinc are not safe pigments on galvanized iron.

Repainting Galvanized Iron.—To repaint galvanized iron, note the character of the primer first applied; if well bound to the surface, clean thoroughly, and if to be painted a similar or darker color, apply but one coat. This should carry sufficient turpentine to penetrate and bind well to the old coating. It should be well brushed and not heavily applied. If two coats are necessary, the first coat should be mixed half flat and the finishing coat should carry a small amount of turpentine. Full oil reductions should never be used on a galvanized iron surface, as such will cause blistering under extreme heat. If the surface is checked or cracked, go over it with a stiff wire brush and scraper, removing any loose particles of paint and thoroughly cleaning the surface. Touch up any bare spots with red lead paint. This will even up the surface, and it can then be finished with one coat of paint, which should not be mixed too elastic. If the paint is peeling or is not properly bound to the surface, scrape thoroughly and clean with a wire brush to the bare iron, then rough up the surface and proceed as for new work.

PAINTING METAL CEILINGS

If the stamped metal has been primed at the factory it will have been done with varnish thinned with benzine, and to this a little zinc-white will be added, not enough to render the paint opaque, but to leave it rather translucent. If the metal has not been thus coated it will be necessary, when ready for the painter, to clean it well with benzine or strong sal soda water, to remove the grease and dirt. When clean and dry apply a coat of raw or boiled oil, without pigment of any kind. If raw oil is used, then add a little litharge to help it dry. Upon this primer any desired paint may be used. But it is advised not to use a gloss paint, which becomes dirty and worn-looking, just as soon as any dead flat paint would, and with it the light will not be distributed over the room as well.

The following method is that given by an expert decorator: After making the metal clean make up the first coat with white lead, and raw oil and turpentine equal parts; tint this to the color you are going to finish with. When dry, coat over with white lead thinned with turpentine only. Tint it the same as the first coat. If this coat is stippled it will help the appearance of the finish. Stipple as you apply the paint. The decorative part may be varied according to the price you are to receive, and to your taste. Never use ready-mixed paint on these ceilings, nor a gloss paint. A flat finish will not show any defects as a gloss finish will.

MARINE PAINTING

The protection of a ship's bottom with some protective material has for years engaged the interest of scientific men, and the conclusion has been reached that for iron that has to be under water all the time nothing is as good as red lead mixed with boiled linseed oil, followed by a good varnish paint. Some claim that raw linseed oil is better than the boiled for this purpose. Andes says that tests show that salt water is less injurious to oil paint than fresh water. An oil paint that will stand the test on glass under water has been shown to have no protective value on iron under water.

But a paint for this purpose should not only be capable of protecting the hull from the effects of the water, but should in addition prevent the accumulations of sea animals and algæ. This is obtained by a closely adhering, smooth coating, which has mixed with it poisonous substances that kill the plants, mollusks, and other organic formations that attach themselves to the ship's hull, and which also possesses the property of peeling off in a thin layer where the dead organisms are situated, without exposing the hull of the ship. There are many elaborate compositions calculated to effect this object, yet it must be acknowledged that to date there is no absolutely sure anti-fouling paint.

Boat Painting.—An expert boat painter gives the following method for painting a new boat: Sandpaper smooth and prime with white lead thinned with oil, raw, three parts, and turpentine two parts, with one part white liquid drier, for a white job. If to be done in any color, then tint the priming to suit the color. If the exterior is to be green, then make a lead color primer. Allow several days to elapse before applying the next coat — a week, if possible. Second coat, if white job, mix equal parts of pure lead and zinc white in oil, to be tinted with an oil color if the finish is to be in color. Thin with turpentine and a little drier, so that it will dry nearly flat, and allow several days to harden. Then sandpaper. For white finish thin a good grade of zinc white in oil with a first-class spar varnish, of fairly pale color, to a flowing consistency. For colored work, add to this before adding the varnish, the desired coloring. Do not flow it on, but brush out evenly and not too heavy. If the hull is to be green or any other solid color, thin the oil color for the second coat, also, so it will dry flat, and add spar varnish for the finishing coat.

Painting Canvas Boat.—Mix 7 lbs. white lead ground in oil, and 3 lbs. whiting thinned to a stiff paste with boiled oil, adding an ounce of common yellow soap, dissolved in one-half pint of water; apply this to the canvas in a heavy coat, and when it has set, but before too dry, scrape away with a knife or wide-bladed spatula excess paint, leaving the canvas well filled. Let dry, then give it another coating of the same paint, a little thinner, and when dry, sandpaper smooth and finish with any desired color of paint, mixed in oil.

The method used in the British navy yards is similar to the above: Eight lbs. best yellow ocher ground in oil, boiled, and 1 lb. of lampblack, in boiled oil, are mixed, making a paint with a very dark green hue. To this add one ounce of yellow soap dissolved in hot water, one-half pint. Apply stiff, and allow three days for drying. Then make up a similar paint, omitting the soap, and adding a larger proportion of boiled oil, which should dry free from tack in three days. After this any oil paint of any desired color may be applied. The first two coats make the canvas waterproof and keep it from rotting or cracking. In order to get the best wearing job, avoid inferior materials, especially oil, turpentine, and varnish.

The United States navy, after long experimentation, painted a large part of its fleet with pigment composed of 45 per cent. zinc oxide, 45 per cent. blanc fixe (artificial sulphate of barium), 5 per cent. of lampblack, and 5 per cent. of graphite. This was mixed with the proper linseed oil and driers, and it was found to cost one-third less than the old lead and zinc paint which the navy formerly used, and gave not only a better looking paint, but one that held its gloss longer, and was not acted upon by salt water.

Steel-covered boats, fresh water, painted below water-line with red lead and zinc white, half and half, always stood.

A paint that has given excellent results when used on the interiors of trimming tanks of submarines is made of a graphite pigment and an asphaltic oil thinned with benzine. This paint has displayed remarkable protective qualities when used under the trying conditions mentioned above. Red lead, though used generally for the purpose mentioned, does not give results that are even satisfactory, due to the fact that linseed oil films do not exclude water, and red lead paint made with linseed oil will not adhere properly to a surface that has the slightest trace of moisture.

Another paint that has been used extensively at the Brooklyn Navy Yard for uses to which red lead has been put, is composed of a pigment similar to Venetian red, containing iron oxide, calcium sulphate and silica, and of specially high quality linseed oil, turpentine and driers. The merit of this paint appears to be due to the special quality of the linseed oil and the care used in manufacture, and, though it is somewhat more expensive than the others mentioned, the paint is much cheaper than red lead, and appears to be more effective.

Boiled Oil.—It is said that ship painters will never use boiled oil in a paint that is to be subjected to hard use or jarring, they claiming that such paint will break clear to the wood.

Cork Varnish.—To protect the interior of a ship from the humidity caused by the condensation upon the metallic walls during sudden changes of weather or temperature, cork varnish is used. This is a compound of ground cork and copal varnish, with some litharge, and is said to be very effective.

Refinishing a Hardwood Deck.—Clean the deck and remove old paint with a varnish and paint remover. After getting all cleaned down to the wood, apply a hot saturated solution of oxalic acid, using a rag swab. This will remove stains and leave a bleached surface. Then apply a coat of wood filler. When dry sandpaper, dust off, and apply a coat of good spar varnish. Let stand two days and then apply another coat of spar varnish.

Marine Putty.—The best putty for boats below the water line is made as follows: In 7½ lbs. of raw linseed oil boil for 2 hours 4 lbs. of burnt umber, then add and stir in 2 oz. beeswax. When the wax is dissolved take from fire and allow the mass to become lukewarm; then stir in and mix thoroughly 11 lbs. whiting and 2 lbs. dry white lead. Knead the mass, adding more whiting if necessary to make it of putty consistency. Keep in water to prevent it from becoming hard.

Another Marine Putty.—Whiting 15 lbs., Portland cement 10 lbs., sublimed white lead 10 lbs., litharge 5 lbs., raw linseed oil 1 gallon.

This putty will harden under water.

Paint for Torpedo Boats, Etc.—The color produced will be bottle green, and the formula will give 25 gallons of paint. White lead in oil 200 lbs., medium chrome yellow in oil 15 lbs., lampblack in oil 15 lbs., raw linseed oil 10 gals., turpentine 2 gals., japan drier 2 gals.

Paint for Yachts.—For the white enameled yacht, top strokes and combings, prime with pure white lead, mixed with equal parts of boiled and raw oil, following with two coats of pure zinc oxide mixed in two parts boiled oil, three parts copal varnish, and a little patent driers. After the coatings have become quite hard apply two coats of the best coach or copal varnish. The best protection for iron fittings is red lead thinned with boiled oil, and the last coat may be in a less fiery color, say, iron oxide or Indian red.

To Repaint a Boat.—Scrape off all loose paint but allow to remain any old paint that is in good condition, touching up bare parts. The keel will probably need entire repainting. When all is dry sandpaper smooth and apply a coat of egg-shell gloss paint, then finish as described for new work.

White Enamel or Gloss White.—French zinc white in varnish 8 lbs., damar varnish 5 pints, patent driers ¼ gill. This will make one gallon.

Another formula: French zinc white in varnish, 4½ lbs., damar varnish 6½ pints, patent driers ¼ gill. This formula will give one gallon.

White for Exterior Work.—This paint is intended for exposed parts of a ship; the formula will give 1 gallon of paint suitable for the first coat. White lead in oil 7 lbs., zinc white in oil 7 lbs., raw linseed oil ½ gal., turpentine 2 gills, japan drier 1 gill.

Another formula: White lead in oil 5 lbs., zinc white in oil 9 lbs., raw linseed oil 3 pints, turpentine 4 gills, japan drier 1 gill.

INTERIOR WHITE PAINT.—This paint is intended for store rooms, magazines, etc. The formula gives a gallon of paint. White lead in oil 7 lbs., zinc white in oil 7 lbs., raw linseed oil 1 quart, turpentine 1 quart, japan drier 1 gill.

FLAT WHITE PAINT.—This paint is intended for use in such places as officers' quarters, etc. The formula makes one gallon. French zinc in oil 8 lbs., white lead in oil 9 lbs., turpentine 3 pints, raw linseed oil 1 gill, japan drier ½ gill.

Another formula. French zinc white, in oil, 17 lbs., turpentine, 3 pints, patent driers, mixed thin, ½ gill.

SPAR COLOR.—This paint is for spars, davits, smokestacks, ventilators, etc. The formula will yield one gallon. White lead in oil 16½ lbs., French yellow ocher in oil 1½ lbs., raw linseed oil ½ gal., turpentine 1 gill, japan drier 1 gill.

OXIDE PAINT FOR BOAT TOPPING.—This paint is intended for use on waterways, inner bottoms, and all places where a quick-drying paint is necessary. The ingredients are to be mixed and ground together in a paint mill. The formula will produce a gallon of paint. Venetian red 5 lbs., spar varnish 3 pints, japan drier 2/5 gal.

WINDOW GLASS, GLAZING AND PUTTY

Grades and Sizes of Glass.—The ordinary jobber's stock of American window glass consists of about 75 per cent. "B" quality, and 25 per cent. "A," with about the same proportions in single and double thickness. The usual building specifications fall within these limits.

The only choice in thickness in American window glass is between American single, which averages one-tenth of an inch, weighs about 20 ounces per square foot, and is safe to use against ordinary wind pressure in sizes up to 28 x 34 inches, and double strength glass of about one-seventh inch thick, requiring a counterbalance of 26 ounces to the square foot, and procurable up to sizes whose sum makes 120 inches; that is, 60 x 60 inches, 40 x 80 inches, or anything within these limits. It is hardly safe to use double strength window glass above 40 x 44 inches in exposed situations or in movable sash. If it is desired to economize on the cost of plate glass in a front, the larger sizes of double strength window glass may be used, but only in stationary lights and in protected situations.

The difference in cost between A and B qualities throughout the lists will be found to average about 10 per cent. for ordinary sizes in single thickness, with more in the larger sizes and for double thickness. It is allowable for B quality to contain, in a minor degree, some of the lesser faults incident to its manufacture, i.e., "cords" or "strings," small blisters, either from melting or caused by the workmanship, small burnt patches; that is, where carbon from the gas flame of the flattening oven has adhered to the sheet. It should never be passed if any of these defects are too pronounced, nor if the sheet contains stone, surface cords, furnace scratches, pipe blisters, or is improperly flattened; nor if, as sometimes happens, small broken pieces of glass have become attached to the surface. These fragments usually refuse to come off, and besides their unsightliness, are a source of danger to the cleaner.

In buildings where clear lighting is of no importance, the "C" quality, or "O.B." machine brand will save a little, but the buyer must be prepared to pass any defects in glass except "stones." By this is meant pieces of foreign matter, clay from pots and tanks of material not thoroughly crushed; such blemishes are not permissible, because under stress and unequal weather conditions they are almost sure to crack the sheet and necessitate replacement. For ordinary mill, warehouse and cheaper household construction, "B" quality is usually specified, keeping in mind that the smaller the size the less the price for the glass, though not, of course, for the sash construction.

The ordinary "A" glass of commerce is the highest quality the factory produces above "B," very little selecting being done above the former. If "AA" is ordered from a jobber, he will open a few boxes of "A" and select therefrom such sheets as he thinks will pass inspection. In "A" glass no cords of any kind should be passed, no stones, no gatherers' blisters, except the occasional small "blib" caused by the melting or very fine dust blisters, nor any glass that is wavy enough to distort vision.

In specifying any quality and thickness of American glass it is well to require a tank-made, hand-blown, natural-gas and dipped brand.

Hand-blown glass is to be preferred to machine-drawn because of its greater reliability in withstanding the strain due to changes of temperature. Machine-drawn glass cylinders were first made by one John Lubbers, of Pittsburgh, in 1895, and though at first very inferior in quality, have been much improved. They are not desirable, however, when a thoroughly reliable article is called for. Tank-made glass is to be preferred to that melted in pots, inasmuch as it is made with a salt-cake base and not liable, like the pot-melted, to fade in the course of time. Dipped glass means that the sheets, hot from the lehr, are dipped in hot water and acid, removing from them all traces of sulphur stain. Glass made with natural gas is to be preferred, because it carries no excess of carbon, it is not likely to be burnt, that is, have the small particles of unburnt carbon adhere to the surface of the sheet.

The next step in quality from American is the so-called French, which is usually Belgian-made, and runs fully 25 per cent. better than corresponding American qualities, though it is lighter in weight than the corresponding grade of the American, the single being usually about one-tenth inch thick and weighing 17 ounces to the square foot, the double, about one-eighth inch thick, and weighing 21 ounces. In small sizes, up to 10 x 15 inches, the French glass usually sells in New York at the same price as the American, and the difference is not very great up to 16 x 24 inches. Above this freight charges, breakage and tariff make a difference of a few cents per square foot.

If the very best blown glass is desired, the English must be specified. This is rated by weights per ounce to the square foot, and the 21 and 26-ounce qualities are most frequently used. English glass may be readily mistaken for plate glass, as it contains almost no waves and no defects except an occasional very small blister.

As to plate glass, there is little to say, American glazing-quality plate being the usual specification. If a better grade is desired, "silvering" quality may be called for, and if the best, "French silvering," this last being as near perfect a glass as is produced commercially. It is almost silver white, whereas American plate is usually a little green in color. It is procurable any size and thickness for special purposes; the usual glazing thickness is about one-fourth of an inch and weighs three and one-half pounds per square foot. The only defects apt to be found in plate glass are bubbles, and occasionally a gray spot where the polishing is not perfect. An excess of any of these imperfections is sufficient cause for rejection.

Common window glass is made from silica, soda and lime. Crown glass is of a higher variety of window glass, being produced by a different manipulation of the blow pipe. It is of greater luster and beauty, yet as only small panes can be cut from a sheet, it is superseded by other products. Plate glass is made from sand, soda, lime, arsenic and charcoal, and is formed by casting and rolling on a table; there is much waste in the grinding, and the entire process is very expensive.

Glazing Window Glass.—After the sash have been primed with white lead made quite thin with raw linseed oil, with a little japan drier, and left to become quite dry, they are ready for glass and putty. In some cases the sash are not thus painted, for it may be intended for natural finish. In such a case oil alone may be used, with some driers in it. Again, it may be that the outside of the sash is to be painted, and the inside stained or finished natural. In this case it is best to oil both inside and outside of the sash. In the factory where the sash are made they are dipped in a priming liquid, consisting mainly of rosin oil. Putty will not long adhere to such a primer. They also stain the liquid with color, such as Venetian red, or dip in a mixture of whiting and rosin oil. If the sash are then glazed at the factory the putty will be on a par with the primer; of course such glazing is too poor to stay long on the sash.

To glaze, an easel is necessary. This may easily be made from some strips of wood. First lay the sash down on a table, muntins up, and with a handful of glass proceed to lay the lights in the openings; the crown side up. Sometimes a light will not fit, but by trying several openings it may fit one of them; if it will fit none, lay it aside and if needed to finish with, cut off the excess size with the glass cutter. As a rule glass is better for being bedded. This means the placing of some putty in the muntins before laying in the glass; this is especially desirable when the glass is not straight. The bedding may be done by taking some putty and pushing it on to the muntin with the thumb. Then place the glass in the opening and press down gently. Place the sash on the easel and proceed to glaze it, first having secured the glass with some glaziers' points.

It requires time and practice to glaze rapidly. The expert takes up a small lump of putty in his left hand, with putty knife in the right hand, and pushes some of the putty under his thumb, feeding it thus to the thumb as he presses the putty down firmly in the muntin, and against the glass. He will thus putty the space as fast as his hand can give the putty. Any surplus putty remaining he will deftly take up on his putty knife. The putty should not quite come up to the outside edge of the sash, but should rather be a trifle below, so that it will not show from the outside.

The corners must be neatly cut, and the putty made smooth and firm.

When the sash is done, take a duster and wet it in a basin of water, which should be at hand, and brush over the glass next to the glazed parts, and the grease left by the putty will wash off; if left to become dry it will be very difficult to remove.

The driving in of the zinc points may be done with a heavy chisel, the beveled edge against the glass, but there are tools that do the work faster, such as the stripping machine or point driver. But for the ordinary glazing that the painter has to do the chisel answers very well. In driving the point see that it goes far enough into the wood to clear the edge of the wood showing beneath, so that the point will not be in the way of the putty knife. Use a size point fitted in length and breadth to the size of the glass; use one neither too large nor too small. There are sizes enough to fit all sizes of glass. Fasten the light so that it will be fast to the wood, not liable to move and so disarrange the putty. If the glass is too short or too narrow, it may be well to fasten it in place with a tack. Never cut out the wood to fit a glass too large for the opening; cut the glass.

For a quick job of sash priming, use raw oil and driers, or boiled oil, as these will dry much sooner than white lead priming.

For bedding small lights quickly the following plan is suggested: Roll out some putty on a glass or marble slab, using a rolling pin, and roll out to such thickness as may be determined by the amount of putty required. Take up the putty on the edge of the glass, filling the four edges; then drop the glass into its place and press down; drive the points and then glaze.

Glazing a Skylight.—Prime the sash in the usual way, and when it is dry take some new muslin or linen and cut in strips that will cover bar and glass on either side of frame to about an eighth-inch; then paint the bar and strip and lay the latter on the fresh paint, starting at the bottom and working up to the top, rubbing out the creases. When dry, give it another coat of paint. This method has proved successful and has kept water out for six years.

Putty Marks on Ground Glass.—It is difficult to remove putty from ground or other rough-faced glass, and yet it must be removed. There are several plans advised, one of which is to remove the putty by means of lye, using a small swab. The putty will soon disappear, then wash with clear water. Some advise rubbing along the glazing part with soap, others say a raw potato. But as in either case the object is to prevent the putty from adhering to the glass it would seem that unless due care were exercised that the putty in the sash would not hold where it touched the glass. By being very careful very little putty will get onto the glass.

Hanging Sash Door Sash.—Should the sash that is placed in a front door be hung with the putty side or other side out? This the carpenter decides, and as a rule the sash shows the putty outside, though not always. We think the sash and door will look better with the putty inside. As concerns an old sash door, we leave it as we found it, of course.

What is a Good Day's Work Glazing?—One authority says that taking average small lights, say up to 10 x 12, a man should be able to glaze about ten lights per hour. But a boy, glazing in a mill, will do very much better than that. These young glaziers will do 60 sash with lights 8 x 10, nine-light sash; this would amount to 540 lights per day. But these boys do nothing else, and long experience makes them very fast at the work. The painter does such work only occasionally.

Amount of Putty Required.—Estimating that one pound of putty will run 20 feet of sash rabbet, ordinary size sash, and about 15 feet on large sash rabbets, 60 sash, 8 x 10 size, nine lights, should take, for the 1,620 feet of rabbet, about 81 lbs. of putty, including the waste.

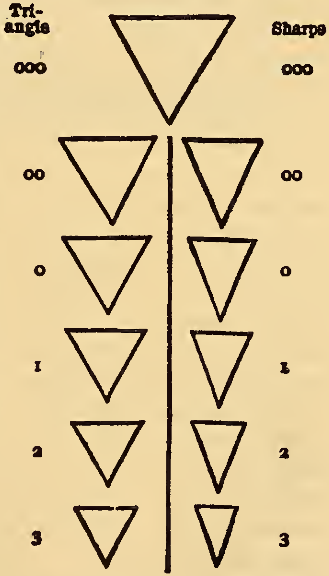
Removing Old Glass.—The usual method is to cut out the hard putty with a hack knife and hammer. Unless very carefully done this plan is apt to cut and disfigure the wood, and break the glass. One painter says that he removed 100 lights at one job without cracking a glass by means of the blow-torch; he uses a small torch, with the flame only about half-way on. If there are many glasses to remove or much old putty to take out, better unhang and take out the sash.

Scratches on Plate Glass.—If the scratch is not very deep it may be removed by rubbing a powder made from powdered chalk 60 parts, tripoli 30 parts, bole 15 parts, mixed, reduced to a fine powder, and sifted. Wet the scratched part with water, dip a piece of muslin in the powder and rub the scratch; repeat this until the scratch is gone. A deep scratch will have to be ground out with the finest emery flour, such as opticians use; then the part must be rubbed to a polish with rouge and water, with a piece of soft leather. Or grind the scratch out with a buff wheel of wood, with fine pumicestone flour and water. Very slight scratches may be rubbed out with a pad of raw cotton charged with jewelers' rouge.

Removing Old Putty.—Remove the sash and lay it flat on a table, putty side up. Take a spring-bottom oil can of small size and fill with benzine or gasoline, and squirt a little of the fluid along the putty; apply a lighted match to it. It is said that this will soften the old putty in a few moments so that it may easily be removed with the knife. It may require a second application in some cases. Perhaps denatured alcohol would do as well, and it is not as dangerous to use. In using the benzine or gasoline be careful there is no other fire near.

GLAZIERS' AND GLASS CUTTERS' TOOLS

GLAZIERS' POINTS.—In the beginning of the use of window glass it is probable that the lights were fastened in with small triangles of tin, where the glass was not leaded. Sometimes we come across these tiny tin points when repairing ancient sash. To-day we have the factory-made zinc points of various sizes, adapted to the requirements of large and small lights. These points come in sizes ranging from 3, the smallest size, up to 000, the largest. They come in paper packages holding 1 lb., ½ lb. and ¼ lb. You can buy all sizes in the ½ lb. boxes, while the ¼ lb. boxes contain Nos. 0, 1, and 2 only.



There are double-pointed points for green-house and hot-bed glass, in sizes 1, 2 and 2½, each box containing 1,000 points. They are known as Van Reyper's points.

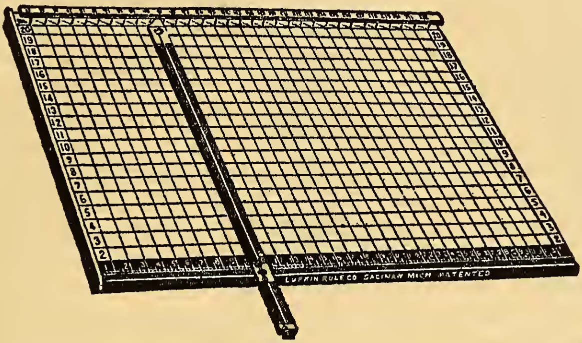
The common tool used by painters for driving zinc points is a heavy chisel, using it with the bevel cutting edge next to the glass; they are a very satisfactory tool. There is a hammer with a rotary head, triangular in shape, with faces adapted to the different sizes of point. The fact of the head of this hammer being rotary enables the workman to hold the handle at any angle while the head is flat against the glass. The other end is made of malleable iron in the form of a hammer and useful as a hammer. This tool is nickel-plated and the angular head is made of tool steel.

THE HACKING KNIFE.—This tool is intended for hacking out old putty from the sash, driving it by means of a hammer. The blade is hand-forged, the handle of stiff leather, firmly riveted. The knife may be had in lengths of 3½, 4 and 4¼ inches, and in width about 1⅛ inch; thickness ⅛ inch. These knives are made for both light and heavy work.

PUTTY KNIVES.—These come in different styles and at different prices, according to style, quality of steel and finish. There are stiff and elastic blades, with square or bias point, also double pointed or diamond point. The choice is a matter of personal liking; some like a stiff, others a flexible blade; some prefer a straight or square end, while others select that having a bias shape.

The blades are usually about 4 inches long, though some exceed this length. There is also a trowel putty knife, glazing knives, and half-elastic wide putty knives, the latter useful for scraping off after the gasoline torch. The blade is about the width of the flame, or two inches. The length is nearly 4 inches. There may also be mentioned "filling" knives, putty knives of rather wider dimensions than the ordinary glazing knife and something longer; they are elastic.

GLASS CUTTING BOARDS.—These boards are marked off into inches and fractions thereof on all sides, with ruled lines across the board both ways. A guide rule comes with the board. It is made so that it will not warp, swell or shrink. It gives a perfect surface for cutting glass upon. The straight-edge cannot slip while you are cutting the glass. One form of board



has illuminated figures, so that it is easy to cut in a dim light.

THE GLAZIERS' RULE.—These rules are capped with brass on the ends, and are 3, 4, 5 and 6 feet in length.

PLATE GLASS CUTTERS' RULE.—These are the same as above, but longer, being 7 and 8 feet in length.

PLATE GLASS ROLLERS.—This is a sort of pliers, intended for breaking away the edges of plate glass after the glass has been cut and a narrow edge left.

PLATE GLASS PLIERS.—This is a similar tool, used for breaking off wider strips of glass.

THE STEEL WHEEL CUTTER.—For ordinary purposes, where not much cutting is required, as with the ordinary painter, the steel wheel cutter does very well. The one containing several wheels, known as the magazine type, is the best. Not that it will cut better than the single-wheel cutters, but you have four times as many cutters in the one tool as in the other. Such cutters will do as good cutting when new as a diamond, at much less cost. Besides which the inexpert user of a diamond will soon spoil it, for it is easily injured by not holding it right or by scratching instead of cutting with it. Even heavy plate glass may be cut with the hard steel wheel.

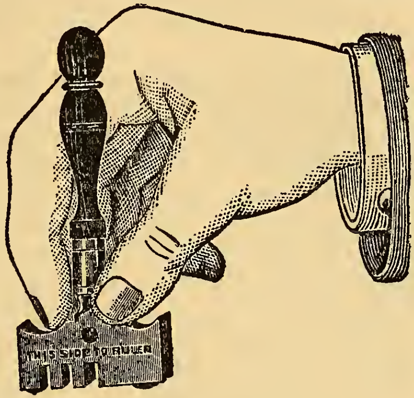
In using the steel cutter draw it firmly across the glass, making a neat cut from edge to edge; do not bear on too heavy. When it has been used a few times it will become more or less dull, then for fear of breaking the glass better turn to the next wheel.

When the glass is old or hard it is difficult to cut it, even with a new wheel; but if you will moisten the wheel in turpentine it will cut better. Old glass is always very hard to cut.

The Steel Wheel Rotary Cutter.—This tool is used for cutting glass in other than straight lines, or in circles and curves. The cutter disk contains six hardened steel wheels, and each or all may be renewed when worn out.

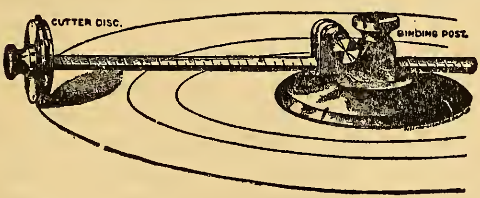
Cutter for Plate Glass Factory Use.—This tool is quite different from any other glass cutter, being intended only for factory use. It is shaped like a rubber stamp block.

The Glazier's Diamond.—These are for ordinary glass cutting, with very small bits of real diamond chip set in the tool, and the price depending upon the size or value of the diamond. As these diamond cutters are tested by an expert before leaving the store the dealer is not inclined to take one back after its sale. Hence it is safer to test the cutter before you pay for it, and if you are not expert the dealer may test its cutting qualities for you. There is a certain way to hold the diamond when cutting with it, and to bear on it and cut. It is easy to ruin a diamond with the first cut. Never run the diamond twice in the same cut. When worn or damaged you can get it reset.



THE UNIVERSAL GLASS CUTTER.—It is very easy to cut with this popular tool, as it is set squarely on the glass and requires only to be pushed along to insure a clean cut. It has a diamond point, with one size for cutting single strength glass, and another for double strength. It has a full size key for breaking off edges of glass, and in form is convenient for carrying in the pocket.

THE CIRCULAR CUTTING MACHINE.—This tool cuts with a diamond, and comes in two sizes, the smaller one having a cutting capacity of from ¼ to 6 inches. The larger machine cuts from 1 inch to 14 inches. Another and similar device is the



CIRCLE EXTENDING ROD.—This machine may be adjusted to cut from 6 to 96 inches, having an extending rod and the cutting being done with a diamond point.

PUTTY, ITS MANUFACTURE AND USE

Commercial Putty.—The formulas used for the commercial manufacture of putty for glazing purposes are approximately correct and near enough for practical purposes, so that the putty maker can use his own judgment, something depending upon the physical character of the ingredients used; for instance, the finer the whiting used the less will be required. For the very best putty 42 lbs. of gilders' bolted whiting to the gallon of raw linseed oil is used. With what is known as commercial whiting, a much coarser material, 50 lbs. of whiting to the gallon of oil may be used, or perhaps rather less. Foots or oil settlings are used in some putties, and as this is thicker than raw oil it permits of the use of less whiting. About 3 parts of foots to 5 parts of raw oil is used in this grade of putty. Sash putty is what the sash factories use for glazing. It is composed of 70 lbs. commercial whiting and 30 lbs. of marble dust, mixed in a gallon of raw linseed oil and one gallon of foots. Foots weighs four ounces more to the gallon than raw oil. A still cheaper putty is made from equal parts of commercial whiting and marble dust. The thinners are the same as in the other formula, one gallon each of raw oil and foots. Owing to its varnish-like body this foots, or flocculent matter taken from the bottom of the oil after standing a long time, is a great help in the making of these putties.

Skylight putty is made from 75 lbs. gilders' bolted whiting, 25 lbs. dry white lead, 5 lbs. fine silica, 5 lbs. litharge or red lead, and 2 gals. raw oil. This putty is for filling or bedding the sash.

There is a form of putty known as mail-order putty. Formula: Commercial whiting 50 lbs., marble dust 30 lbs., boiled oil 1 gal., and paraffine oil 28 deg. 1 gal. Such putty soon peels from the sash, and any remaining will finally rot.

Shop Made Putty.—Where only a small quantity of putty is required it may easily be made in the shop. Here is a formula for making the best glazing and general purpose putty. Break up 2 lbs. of keg lead in a quart of raw linseed oil; then add by mixing 10 lbs. of gilders' best bolted whiting; stir the mass in a suitable vessel until fit to take out upon the mixing board, when it may be manipulated with the hands, adding more oil if required. A better way is to place the whiting in the vessel and pour the oil over it; let it be until the oil has percolated through the mass, when the white lead may be mixed in with the mixing stick.

Putty may be made upon a larger scale by using a barrel, an oil barrel doing very well; in this, place 100 lbs. of gilders' bolted whiting and on top of it pour 18 lbs. of raw linseed oil. The oil weighs 7¾ lbs. to the gallon. After some hours the oil will have permeated the whiting, forming a sticky mass. Keep the barrel covered, and when you require some putty take it from the barrel and incorporate whiting with it to form a workable putty. This is a very elastic putty and will not harden perfectly in less than three years, and in some cases has been found not perfectly hard in six years.

It should be remembered that glazing putty needs considerable kneading to make it the best. In the factory the whiting and oil are placed in a mill of dished form, in which a pair of very heavy iron wheels go round and round over the mass for a long time, or until the putty is perfectly homogeneous. After that the putty is cast upon a table where it remains for several days, to sweat out, as they call it. It cures or ripens by that time, and is then a very tough and elastic putty. So that the shop made putty should be rolled and even hammered if one is to get the very best results.

WHITING.—There are several grades of whiting, the commonest or cheapest being known as commercial; it is very coarse and always damp. Marble dust is used in putty making, but then it is not a whiting. The commercial whiting is very much like marble dust. Even the best whiting may prove to be inferior at times, owing to imperfect manufacture, for whiting is made from lump chalk, which undergoes various processes, boiling, for instance, which relieves it of its sulphur. Sometimes the whiting will be badly sifted or levigated, and full of coarse pieces and lumps. When whiting contains free lime it is bad.

In any case whiting should be made perfectly dry before it is made into putty, though this is not always done, because damp whiting takes up less oil than dry whiting. In fact, water is added when a cheap putty is made. And into cheap putty such things as rosin oil, fish oil, petroleum oil, etc., are used, forming a vile compound, one that stinks, but does not stick. Poor putty always has an unpleasant odor, quite different from pure oil-and-whiting putty. Cheap putty is always heavier than pure putty, for you can place 30 lbs. of the former in a can that will hold but 25 lbs. of the latter. This indicates a loss to the buyer who pays for five pounds of waste material from which he gets no good. Some cheap putty is mixed with deodorized mineral oil, and such putty never hardens; the addition of a little white lead to it will assist its hardening.

REMARKS ON PUTTY.—Putty should have the right proportions of adhesive and cohesive qualities, should dry slowly, and in drying should expand and fasten to the walls of the nail hole or to the woodwork of the sash and to the glass; it should not contract, crack or fall out. Putty is sometimes put up in hog bladders, which prevents drying out; it is also put in tins, another good way. The 25 lb. cans are good for paint cans after being emptied, and while they contain putty keep the lids on. Any putty left from a job should be put in one of these cans, and will then be fit for the next time. This is better than keeping it in water. If putty is too soft when taken from the can add some whiting to it; lay the putty on a board and sprinkle whiting over it, which will absorb the oil. Then mix and knead well.

Putty made with mineral oil will cause white paint that is applied over it to turn yellow, and will also cause the paint to peel off, with some of the putty with it. When such putty is used to fill nail holes over which dark paint is applied it will cause color to fade much lighter than the rest of the work. It retards the drying of the paint also. When you get a putty that will not dry in the usual putty way you may be sure that neutral petroleum oil has been used in its making; the addition of some litharge or red lead will assist the drying.

In cold weather putty stiffens and does not work readily, and in this case the addition of a little glycerine, or cottonseed oil or fish oil will help. These keep the putty soft. In warm weather more whiting and less oil is required. Keep some whiting handy, to dip your putty in as you handle it.

Some Putty Formulas

Skylight Putty.—Take 10 per cent. of dry white lead and 90 per cent. of best whiting, add boiled oil to form a stiff paste. Proceed as directed for ordinary putty. The more putty is kneaded the better. This putty is good for wood or iron skylights. Here is one that is adapted for iron skylights. Take paint skins and pot cleanings of the shop and boil; add whiting to form a putty.

Greenhouse Putty.—This must be a rather soft or elastic putty. Mix together 9 parts of raw linseed oil, one part of beef tallow, and enough white lead or whiting or a mixture of both to form a putty. This putty never becomes hard, and therefore allows for contraction and expansion. Liquid putty for greenhouse glazing may be made by adding boiled oil to ordinary putty until thin enough to flow from the glazing machine used for such work.

Soft Putty for Hot-house Sash.—Mix together 10 lbs. best whiting and 1 lb. dry white lead, adding boiled oil enough to form a paste; a few drops of cottonseed or sweet oil, say, ½ gill, will make the putty more elastic and less inclined to dry hard. This putty will do for skylights also.

Some use and prefer a putty for hot-house sash made from dry white lead and ordinary putty, adding as much lead as the putty will take, and adding a little glycerine, to render it more elastic.

Very Hard Putty.—For some kinds of work an extra hard kind of putty is required, for brick fronts, for instance, and any exterior work requiring quick and hard drying putty. Mix dry red lead with boiled oil and varnish. This putty must be used soon after its making, as it quickly hardens.

Facing Putty.—For facing up defective work and general puttying, mix equal parts of dry white lead, dry litharge, and the best whiting; add boiled oil, and work the mass to form a soft putty.

To Cause Putty to Harden.—To make common putty dry harder than it would add a little plaster of

Paris, or some red lead. For a less hard putty add white lead instead of plaster or red lead. By using less oil in the mixing and in its stead a little turpentine the putty will be harder. It is a mistake to add too much hardening material when making a hard-drying putty, for it makes the putty brittle, causing it to break up easily. Here is a good formula, one that avoids the use of too much hard drying material. Add some whiting to dry white lead and thin with gold size japan, with a little boiled oil to give it proper elasticity.

Coloring Putty.—For puttying natural woods make a putty from dry white lead, with no whiting, for the latter does not give clear tints. For hard pine, tint with raw sienna; for oak, tint with either raw sienna or French yellow ocher; for walnut, tint with burnt umber; for mahogany, tint with burnt sienna. Make the color of the putty a little lighter than the wood, for the putty will darken a shade in time.

Non-Shrinking Putty.—A very elastic non-shrinking putty may be made from this formula: Take 15 lbs. best whiting, 27 oz. rye flour, and 2 qts. raw linseed oil; mix and knead well.

Swedish Putty.—This also is a non-shrinking putty. It is used on wood, iron, and stone work. To 6 lbs. best whiting add a quart of water and mix to a paste; then mix it with 50 lbs. whiting, 6 lbs. dry white lead, and a gallon of raw linseed oil.

Sawdust Putty.—Mix sawdust from the kind of wood that is to be puttied with glue size, adding some pigment for body, say, silica, barytes or whiting; add some color to match the wood, if the sawdust does not do so.

Mastic Putty.—This is the putty described under the head of Greenhouse Putty. Use only a putty that has sweated out well before it was thinned with boiled oil, or it will cause trouble afterwards on the sash.

Putty for the Motor Car.—This putty must be tough and elastic and sure to stick where it is put. It may be made upon this formula: three parts of lead ground in oil, two parts of dry white lead, and one part of whiting; mix and knead to working consistency with equal parts of rubbing varnish and gold size japan. For a soft plastering or glazing putty use this: Whiting one part, lead ground in oil one part, and dry white lead two parts; reduce to the proper consistency with equal parts of quick rubbing varnish and coach japan, kneading the mass until smooth. Apply one day and sandpaper the next.

A quick and hard putty for car work may be made from one part whiting and two parts dry white lead, mixed to the proper consistency with equal parts of quick-rubbing varnish and pale drying japan.

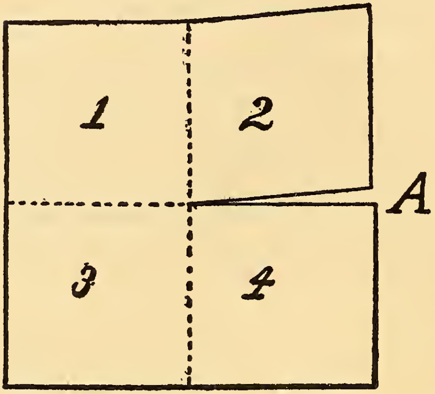
SANDPAPER AND ITS USING

Sandpaper and Using It.—Though we no longer have "sandpaper" the ancient name sticks, and will to the end. Crushed quartz gives us a much better abrasive than sifted sand can possibly do. And there are more degrees of fineness than formerly prevailed, these ranging from the grade that is soft as the downy cheek of a babe, on up by gradual steps to a paper that might serve as a section of repair for a macadam roadway.

It is important too to have degrees of fineness adapted to the many kinds of work sandpaper is required to make smooth. And the workman must use the paper carefully, so as not to injure the surface that is being rubbed. A fine finish can easily be marred by careless smoothing, or by the ignorant use of the wrong grade paper.

Some old finishers split the paper, when it is desirable to do certain parts and surfaces, and sandpaper may be had that has both sides coated, so that in splitting it you have two sheets of fine paper instead of one. The split is started in the making, so that all one has to do is to pull at that part and the splitting is easy.

It is usual with painters to take a full sheet of sandpaper and fold it in two parts, then run the putty knife through it and separate the paper. For this purpose it is best to fold with the sand side in, otherwise the paper will tear ragged. Then the half-sheet is again folded and cut. If it is wished to fold the sheet to form one pad, containing four quarters, and which is done where heavy sanding work is to be done, the annexed diagram will give the best method for doing it. By it no two sanded sides come together. Such a pad does for a sandpaper block. The sheet is first cut half way through the middle, as seen at A in the diagram. The diagram shows the plain or unsanded side of the paper. The quarter marked 2 is folded on 1; then this turned on 3 and finally on 4, forming a pad of four thicknesses, no two sanded surfaces in contact.



For good interior woodwork use as fine a paper as will do the work properly; usually No. 1 answers, but it is advised not to use too coarse a paper. It will make scratches that will be hard to sandpaper out. No. 0 or even 00 are coarse enough for fine work.

Steel wool is used extensively in place of sandpaper, but will scarcely supersede the latter. For some purposes it is better to use steel wool, or shavings, for with it one can get into parts that are impossible with sandpaper.

To test sandpaper for quality, rub two sanded sides together, and if the sand comes off easily it is poor. Good sandpaper is tough and elastic, the sand holds well, it is evenly sifted on, and it cuts clean and fast.

It is well to keep a full assortment of the sizes on hand.

To prevent sandpaper from slipping under the hand, chalk it on the back. To prevent dust arising when you are sandpapering lead painted surfaces, dampen it with turpentine; this also causes the paper to cut faster. Benzine with a little ammonia in it is also good for moistening the paper.

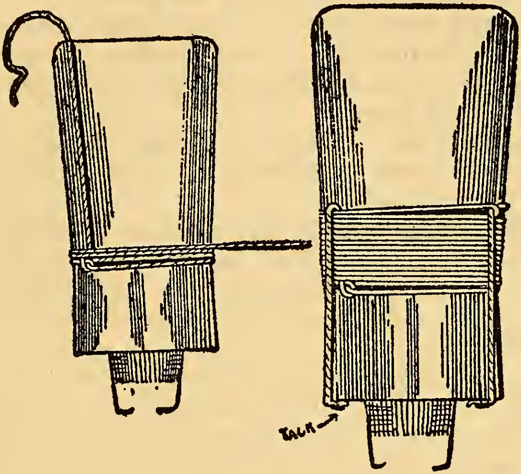
When sandpapering around the edges of an object be careful not to cut through; bear on with a gentle but steady pressure.

HOW TO BIND OR BRIDLE BRUSHES

Many devices have been patented for bridling paint brushes, some with merit, yet none have successfully met the conditions required of a brush-bridling as the ancient hand-bridling has. With a ball of twine of the right thickness and a few tacks the painter can bridle any brush capable of receiving and holding twine. The method is of course not without its weak points, such as the tack in the brush head or in the handle, and which is apt to injure the hand, though as a matter of fact it never does. On a new brush the twine will slip down over the bristles and necessitate re-bridling, but after doing this once it is very seldom necessary again. It is well to not tie too tight at first, but when the bridling needs re-winding then bind it a little tighter, though never tight enough to choke the brush, or cause it to become fish-tailed.

To bridle with twine, the old way, take the twine at its end and hold this against the head of the paint brush with the thumb, allowing about six inches to hang loose along the bristles and parallel thereto; then bring the rest of the twine around and around until you have covered the bristles as far as it should go. This is about one-third of the length of the bristles, though there is no positive rule for this, for the bridling has to be according to what work the brush will have to do at first; better not have too lengthy bristles to paint with, as they scatter paint.

Some painters first tie the first round of twine where the thumb is holding, but many others simply pass the twine around and when the 6-inch end is brought back it is slipped through the loop formed and drawn tight and tacked. The remaining end of the



twine is now brought back around the bristles half-way, and there a loop is formed, through which the free end of the twine is run, drawn tight, and tacked to the brush head and cut off.

To Bridle a Sash Tool.—The method is similar to that described above. Only the two ends of the twine

are disposed of differently; they are either fastened to the handle, a little beyond the brush head, with small carpet tacks, or slits are made in the wood and the ends of the twine are forced in these slits with the edge of the putty knife. The latter is the better way, as it does away with the tack heads, which are too much in evidence when one is handling the tool.

Common brown twine, not too heavy, neither too light, may be used for bridling brushes. Some prefer fishing-line, or cord such as they use with plumb-bobs and for chalk lines.

Soaking a new bristle brush is not to be advised, yet when this is done it prevents the twine from slipping down on the bristles.

Tight bridling causes the bristles to become fish- or swallow-tailed, often thus permanently spoiling the brush. Draw the twine moderately tight only, not too tight. As you run the twine around the bristles keep it up in place.

The object in bridling a brush is to shorten the bristles temporarily, for if too long they will spatter the paint. As the bristles wear down the bridle may be taken off a little at a time.

When the bristles of a brush are too short to bridle with twine, put a stiff rubber band around them.

Paint, in course of time, gets hard under the bridle and should be removed, which may be done by taking off the twine and either putting on new, or by making the old clean; also scrape away the old paint. By keeping the butts of the bristles clean the brush will regain some of its old elasticity and do better work, and last longer too.

SCAFFOLD AND LADDER WORK

To the painter unaccustomed to working from a swing, as the hanging scaffold is called, the structure suggests to his mind every possibility of a tragedy, but the experienced hand regards it with pleasure, as it is much easier to work from a swing than from ladder, jack, or any other device. If the ropes and swing stage are all right, as they should be, and in careful hands will be, there is no danger at all to the workman using it. The ropes are the first consideration. They should be the best made. To tell good rope from poor observe its color; a good rope will have a bright, clean, smooth appearance. Made of good hemp, the rope should be hard yet pliable, of a yellowish or greenish-gray color, and with a sort of sheen to it, silvery or pearly. A dark color shows that in the process of curing the hemp has suffered from fermentation. Brown spots indicate that the fibers were wet when the rope was spun; such a rope is soft and weak. Rope is sometimes made from inferior hemp covered with good hemp on the outside; this may be found by cutting a piece of the suspected rope and examining it. Some ropes are made by using short fibers or fibers of uneven length, or they may be unevenly spun. The first case is disclosed by the woolly appearance of the rope, the ends of the fiber projecting. Close inspection may result in finding other faults; a faulty rope is a dangerous thing in connection with a swing stage.

The knots in a scaffold rope should be examined often, as they settle down and are liable to give way.

It is a good idea to reverse the ropes once in a while, taking them out and changing them end for end. In this way parts that have the least wear will be required to take the place of the parts that have had most wear. It is not safe to allow the ropes to remain in one position until worn out.

Keep the ropes in a dry place, neatly coiled, and hung up. It is usual to coil four strands of falls at one time, but a better way is to pull the two blocks together and lay the rope around them in a neat coil, then securely tie in the usual way. When a coil is to be opened it should be turned upside down and the hoisting rope attached to the hook on the upper block, and a line fastened to the hook on the lower block, to haul it down again. This will be found an easy way. First, it is a much lighter lift to get the tackle to the roof, a fact that will be appreciated when it comes to a lift of six to eight stories. Secondly, it avoids many twists that occur by doing it the other way. Thirdly, it allows you to adjust the falls more readily to the height of the job in hand.

When in use for hauling up the stage, the rope is bending and straightening as it goes around the pulleys, causing the strands to chafe at the center of the rope. The smaller the pulley the worse this is. For this reason the rope should be run over a pulley of a diameter not less than eight times the diameter of the rope.

Knots weaken a rope because the rope is bent in order to form the knot, and the outside takes the strain at the bend. These are overworked and break. The strain then rests on fibers below, which in turn weaken and break.

There is a right and wrong way to coil rope. Because of the way it is twisted in the making, it should be coiled as with the hands of a clock. In uncoiling the rope the end last laid down should never be pulled up from the top. If for any reason this must be done turn the whole thing over and draw the end up through the center.

To preserve a rope against dampness make a strong solution of copper sulphate, immersing the rope in this for about three days. But see that the rope is dry before putting it in the bath. This is important. After taking the rope out of the solution hang it up where it will dry soon, and don't put it away until it is dry.

Tying Knots.—The advantages of a good knot are: its ease of tying and untying, its freedom from slipping, and its requiring very little rope to make. It also increases the confidence of its user. The knots here shown are loosely made in order to show clearly their true formation. A good test of proficiency in making knots consists in doing the work in the dark.

All knots will jam more or less when under a strain. A true knot will hold, not let go.

The names usually given to knots, and their uses, are as follows:

1. Bight of a rope.

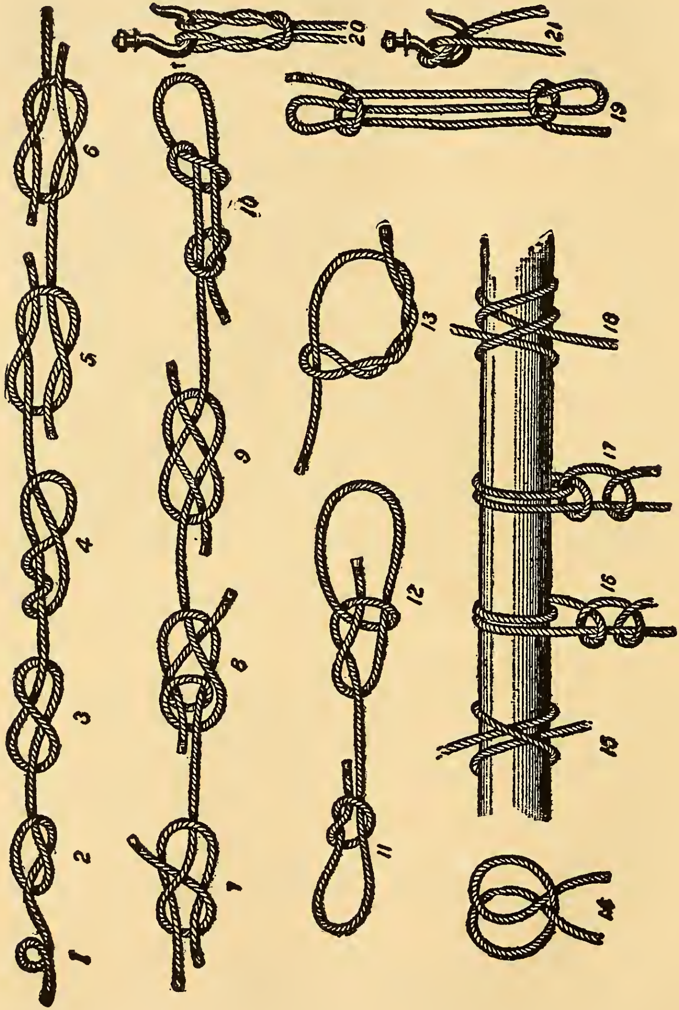
2. Overhand or thumb knot—To prevent a rope from running out through the sheave of a block.

3. Figure 8 knot—Used same as No. 2.

4. Stevedore knot—Useful when the rope passes through an eye. It is easily untied after being strained.

5. Square or reef knot—Useful in joining two ropes of the same size. However tight it may jam, it is easily untied.

6. Granny or thief knot—This knot is not a safe one, and is the one most commonly tied by people. It is frequently tied in mistake for a square knot. It is likely to slip under a strain, and it is hard to untie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when set. Some say it does not slip, though it will jam tight. In any case it is not a desirable form of knot.

7. Single sheet bend or weavers' knot—Used principally for joining two ropes of unequal sizes more securely than a reef knot.

8. Double sheet bend—A more secure knot than No. 7.

9. Carrick bend—Used in fastening the four guys to a derrick.

10. Flemish loop.

11. Slip knot.

12. Bow line—For making a knot that will not slip; as safe a knot as it is possible to make. Useful when a loop that will not tighten is wanted on the end of a rope. After being strained, it is easily untied. Commence by making a bight in the rope, then put the end through the bight, and under the standing part; pass the end again through the bight and pull tight. This knot should be tied with facility by every one who handles ropes.

13. Timber hitch — The greater the strain the tighter it will hold.

14. Clove hitch—Consisting of two half hitches, and used chiefly to tie ledgers to standards. On account of its simplicity and security, this is the most useful of all the knots.

15. Shows the clove hitch around a pole.

16. Round turn and two half-hitches, for securing a rope to a ledger or for fastening the guys of derricks, shear legs, etc.

17. Fisherman's bend—Used when a thick rope, such as a fall, is made fast to a ring.

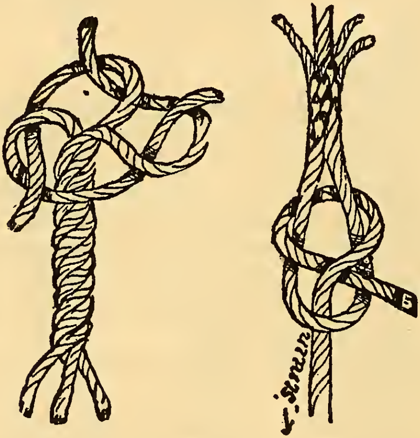
18. Rolling hitch—Used in a variety of ways, but chiefly in making fast one rope to another that is held taut.

19. Sheepshank—For shortening a rope when the ends are inaccessible.

20. Catspaw—An endless loop, used where great power is required.

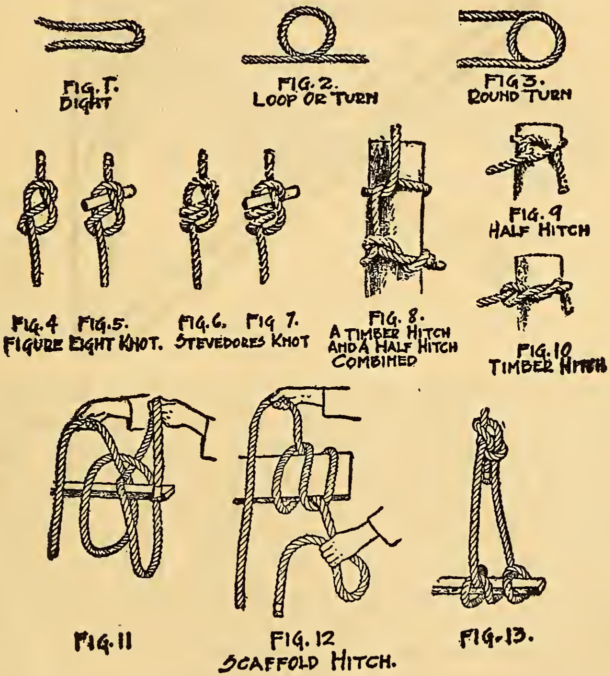
21. Blackwaller—Easily applied, but requires watching, as it is liable to slip.

The ends of ropes are often left to unravel, and often several feet are cut away on this account, when



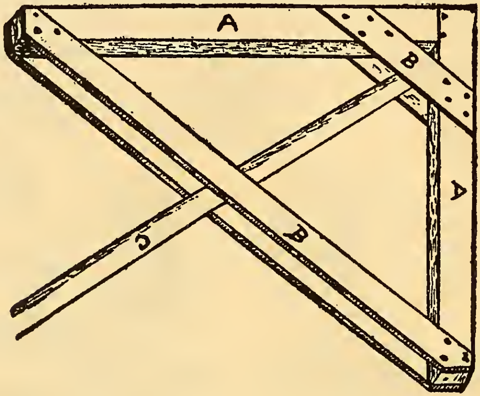
by simply binding the frayed ends with twine, or by making a *wall crown,* as shown in the illustration, the rope might be saved.

Making a Scaffold Hitch.—The illustration shown has reference to a knot that is especially useful in scaffold work. Taking the figure shown on the left, draw to the left the rope in the left hand, and to the right the rope in the right hand, gaining the position shown in the middle illustration. Turn the plank over, draw the ropes up above it, join the short end to the long rope, by an overhand bowline, pull the bowline tight, at the same time adjusting the length of the two ropes so that they hold the plank level, and the hitch is finished as shown in the right hand illustration. Attach a second rope to the other end of the



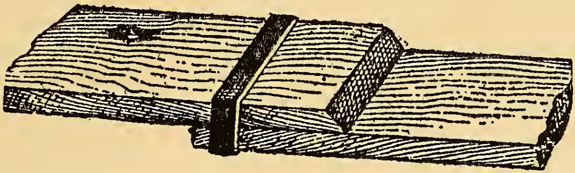
plank in the same way, and the scaffold is ready and safe.

HANDY SCAFFOLD BRACKET.—This bracket will be found useful in country work, its particular usefulness consisting in its handiness where there is a tall gable, for instance, on a job that will not warrant the setting up of a regular scaffold, and which cannot easily be done from a ladder. The more weight you place upon this scaffold the firmer it holds. It cannot slip and is perfectly safe. Take some 3 x 4 straight



grained wood and saw off two pieces about three feet long, and two pieces about four feet long. Place as shown in the diagram, the shorter piece on top. Then saw out strips of sound board about the width of the angle pieces, and saw off to fit as shown. There are strips on both sides of the bracket. To place these two brackets in position, for two at least are necessary, get a long, strong pole and place the lighter end in the crotch of the bracket, as shown, and push the bracket up to where you wish it to be. Do the other bracket the same way. Or by laying a scaffold plank or two on the two brackets before raising them you will have the scaffold ready at once. A ladder to reach to the scaffold will enable you to get on top of it; in some cases a handy window has sufficed. The pole that raises the bracket is slanted so that it will have sufficient foot-hold, and the butt end will set in the earth more or less, so that it cannot slip.

Splicing Planks.—Two planks may be spliced at the end to form a longer plank by means of a strap iron as shown in the illustration. This iron is fastened to the bottom of the bottom plank, or it may be used without being made fast at all.



Raising a Ladder.—When you raise a ladder do not raise it with one leg alone resting on the ground, but see that both legs are resting there. This will prevent strain on the ladder, which in turn causes the rounds to become loose. Also, in taking the ladder down, be careful and do not take it down on a strain.

It seems very simple to see two men put a ladder up against a wall, but it needs care and a knowledge of a few essential things, or a man may be maimed for life, or the ladder broken. The "footing" of the ladder is most important. It is better for two to be at the foot and one to raise it if there are only three men, and if two are raising they should be of equal height, or nearly so. The one that is raising should push up from the sides, and not from the rungs, and do it steadily, and not in jerks. When there are two raising it, each should take a side and push steadily and together. The one "footing" it should place both feet upon the bottom rung (not on the ground, as it invariably slips), and catching the rung above, throw his weight back so as to pull the ladder up. He must never get off the rung until the ladder is perfectly upright and then must act in concert with the one who is raising. When two are "footing" one should put the left and the other the right foot on the bottom rung. When lowering the ladder the footer must not get off until the ladder is right on the ground.

Never use a ladder that has a damaged side or rung. Never take hold by the rungs when climbing; take hold of the sides. When the other man is raising the extension ladder you help him by taking hold of the sides, not the rungs. When footing the ladder pull with the man on the other side. Never slide down a ladder.

Doing Steeple Work.—By the following method a man may climb a pole a mile high. Take an ordinary bos'n's chair with a tail (rope) of sufficient length. Pass this tail around the pole twice, underneath its own part, and once around above, tucking the end under its own part, making a rolling hitch. Get in the chair, take in all the slack rope you can get, raise yourself as high as possible, jamming your hitch tight. Have now a piece of rope of sufficient length, both ends spliced together, pass it around the pole, one turn under and one turn over its own part, tucking the end under, thus making a clove hitch. This is put on about the height of your knees, leaving the loops of your rope hanging down. We will call this rope a *strap*. Place a foot in each loop and raise yourself up; pushing the hitch on your bos'n's chair up as high as you can reach, jam it tight. Sit firm in your chair and draw your feet up, strap and all, as high as you can; then raise up again, pushing the chair up as before, and so proceed until you get to the top.

We sometimes see weather-vanes on the top of a rod anywhere from 6 to 16 feet in length above the church spire. It is necessary to take the vane down in order to re-gild it. An expert says he has taken off and replaced vanes by the above method, some nine feet long and weighing 50 pounds. He has painted many flagstaffs also by this method. The bos'n's chair should fit snug to the hips, and thus situated your hands are free for the work and you are at ease.

Ladder Contrivances.—A handy means of holding the top of your ladder a foot or more from building—convenient for lettering or painting wide cornice—is given as follows: Bore half-inch hole through side pieces of ladder ten inches from top. Take half-inch rod, two feet or more in length, bend at right angles two inches from end—this to fit in the half-inch hole. From the short bend, twelve inches up, bend again—obtuse angle—make two of these, one for each side—place under top round and in the holes, shape them just right and fix to stay in position. The rods can be placed or removed in a moment.

Legless step-ladders for outside work are fine. On a step-ladder of this kind work can be done with more ease and faster. It is easier standing on the flat step than on a ladder rung, and your pot is before you. Have at least three, 6, 8, and 10 feet long. With these you can reach up to 14 feet.

A Pennsylvania painter tells how he painted a steeple. He went to the base of the steeple on the inside, and cut a hole large enough for him to crawl through. When outside he nailed on cleats one above the other, ladder fashion, and began painting at the top, removing the cleats as he came down. He did the four sides in this manner. This method would not, of course, do on a slate or metal covered steeple.

Step-Ladders.—Keep the step-ladders in good condition. Repair any defect as soon as in from a job. Look them up and inspect them. Screw up tight and tighten ropes, or replace weak ones. This will save money for you, as the same work done on the job will take much longer time, and cost more, as a man has not the appliances for repairs on the job, and if the steps are weak or wobbly the workman cannot do as much work from them, being afraid of falls.

How to Carry a Pair of Steps.—Teach the boy how to carry a pair of step-ladders. It might be well for the men to know how also. Many do not know. In going out of a doorway always pass the steps through first, for it is usually the top that does any damage by coming in contact with the door jamb. Keep your eye on the top of the step-ladder, clear it first, and the bottom may be depended upon to look out for itself. The same with trestles and any scaffolding material.

WHITE LEAD—ITS MANUFACTURE AND QUALITIES

A BRIEF description of white lead was given under the head of "Pigments Used by Painters." But a more extended account is given in this place, as its importance justifies. There are several white pigments used by painters, but of them all white lead is by far the most important. It is indispensable, and this cannot be said of any other white pigment.

The chemist tells us that "good white lead will not differ materially in its composition by whatever process it is made, but may differ seriously in its physical character and in its fitness to produce a substance adapted to the uses to which white lead is applied." Let us see what this means.

Good white lead may be a compound of two kinds, one containing two molecules of carbonate, the other three molecules. Or, one part of hydrate and two parts of carbonate of lead, or one part hydrate and three parts of carbonate of lead. The latter is in the proportion of 75% carbonate and 25% hydrate of lead, and this is generally accepted as the correct formula of a good white lead. This seems trifling, yet when we come to understand the subject we find that it is very important. The chemist tells us that the hydrate of lead and the linseed oil in the ground lead unite to form a sort of varnish, it is semi-transparent, and has no covering capacity. But it holds the particles of lead together, a very useful matter. Now, the carbonate of lead and oil produce an opaque compound, which has no body or covering, and in which the white solid carbonate is held in feeble mechanical suspension. Neither, alone, is a paint, but united they form the best paint material known. Now, the proportions of hydrate and carbonate should never exceed or fall below these figures. Yet it will readily occur to you that such a variation might easily occur, doubtless does so occur, and we have some white lead that is not as satisfactory as others.

Little needs be said about white leads made by different processes. No method of making white lead may be considered entirely satisfactory, the ideal way is yet to be discovered; but we get very fair results from any white lead that is worthy of the name, and with this we must rest content.

There are two points desirable, whiteness and fineness. Whiteness indicates perfect corrosion and the absence of impurities and discolorations. The whiter the lead the clearer the tints and whiter the white job. A painter will almost invariably pick out the whitest white lead when offered two different brands. And if it turns out gritty or so-called sandy, he wants no more of that.

There are extremes of color to guard against, the blue tint and the yellow-toned lead. The blue is artificial, and the yellow shows a burnt lead or the presence of foreign matter, due to poor methods of manufacture.

A finely-ground white lead means more wear and tear of grinding machinery, and less output per hour, too. And it takes more oil, also, oil being a costly ingredient. The grinder saves time and machinery and money by not grinding fine, which means also that his product will be thinner than it should be. He loses something in this matter of thin grinding, too, for it takes more oil, yet it pays better than the stiffer and finer grinding.

Careful grinding is required in the making of a good white lead. Too close grinding or friction will result in the graying of the product. A first-class white lead will show perfect whiteness, it will be opaque, or perfectly non-transparent, free from acid, free from water, and free from every foreign matter. Overheating of the mill will make a white lead more or less deficient in body, due to too great saponification of the lead and oil.

In the making of white lead only the purest lead should be used; it must not contain more than the merest traces of copper, iron, zinc, bismuth, or antimony, and not an ounce of silver to the ton of lead, the chemist tells us. All these minerals appear in close association with lead. If they exist in excess of this very small proportion they will show in a low percentage of corrosion and defective color of the finished product.

One of the best points with white lead is, that having added enough linseed oil to it to overcome its chemical reaction, sufficient body is left to satisfactorily hide the surface and afford the desired degree of opacity and whiteness. White lead is perfectly stable in pure air, and is not affected by light. In impure air, however, it is not permanent, being rapidly decomposed by even weak acids, and gradually changing color on exposure to air containing hydrogen sulphide or other sulphur compounds, turning first yellow and finally a dingy brown, owing to the formation of lead sulphide. This discoloration is less rapid in oil paint than in water colors, because of the oil film protecting it; yet the yellowing occurs in time. This discoloration is accelerated by darkness and retarded by sunlight. The sun, indeed, bleaches white paint in the open air. Thus we may take a board that has been painted with white oil paint and left in the dark for a long time, and set it in the sunlight for several days, when the original white color will be more or less restored, this being due to the fact that the lead sulphide has been oxidized to lead sulphate. Therefore, white paint in oil does very well on exterior work, as the sun bleaches out the oil, and the whiteness will be more or less unimpaired, according to the amount of sulphur gases in the air. It is also best to use little or no driers in outside white paint, because driers hasten the drying, and this is only another way of burning the paint; you know that when you overheat white paint it yellows or browns, according to the degree of heat employed. Hasty drying of the white paint, therefore, tends to darken it.

White lead is easy of adulteration, and frequently is found adulterated. Some samples of white lead were found to contain absolutely no white lead at all. The pigment mostly used for the purpose is barytes, because it is most like white lead in specific gravity; if whiting, or similar pigment of low specific gravity were used, it would soon be detected. Pulp white lead is simply that which has been ground in water, forming a pulp that weighs 12 to 20 pounds to the gallon; to this pulp is added the necessary amount of linseed oil; it is then churned much as butter is churned, and in a little while the lead and oil will unite and fall to the bottom, while the water rises to the top and is drawn off. The lead is then packed in kegs. Pulp lead is not considered desirable by most painters. That some water remains in it seems more than likely.

It is advised that the painter test his white lead, thus, for one simple way: Take a very small quantity of the white lead and place it in a saucer, then pour over it some turpentine and mix to about the consistency of cream. Pour this mixture rapidly on a piece of glass and allow it to drain off, when, any grit being present, the same may easily be detected.

Old white lead is usually regarded as being better than the freshly made.

White lead and linseed oil mixed in almost any common proportions of vehicle and pigment give a paint which is readily workable, of good hiding power, and which, after application, produces an elastic paint film that, because of its elasticity, will resist the destructive agencies of the weather better than any other paint. It possesses the ability to contract and expand in response to the seasonal temperature changes without either losing its tenacious grip upon the surface it is protecting or developing cracks and checking because of brittleness.

Some painters contend that the addition of some color to white lead paint adds to its durability, but I think this is not true in the way they think it is. It is not the color or added pigment, but the fact that more oil is required and added. White paint apparently does not cover as well as, say, a gray, made by adding four ounces of lampblack to one hundred pounds of white lead. The gray seems to cover better than the white, hence we feel safe in thinning it out more, and in that way get more oil and greater durability.

White lead becomes rather solid with age, especially in a wooden container, in which case the oil is largely absorbed by the wood, and in any case the oil rises to the top and leaves the heavier lead solid at the bottom. It is true that soft lead is easier to mix, but if very soft in the keg, it may be regarded as being fresh, and hence not as good for painting with as a lead having some age.

The following is regarded as a trustworthy and simple commercial test of the purity of white lead: Take a piece of firm, close-grained charcoal, and near one end of it scoop out a cavity about half an inch in diameter and a quarter of an inch in depth. Place in the cavity a sample of the lead to be tested, about the size of a small pea, and apply to it continuously the blue or hottest part of the flame of the blow pipe; if the sample is strictly pure it will, in a very short time, say, in two minutes, be reduced to metallic lead; but if adulterated, even to the extent of 10 per cent. only with oxide of zinc, sulphate of baryta, silica, whiting or any other carbonate of lime (which substances are the only adulterants used), or if it is composed entirely of these materials, as is sometimes the case with cheap lead (so called), it cannot be reduced, but remains on the charcoal an infusible mass. Dry white lead (carbonate of lead) is composed of metallic lead, oxygen, and carbonic acid, and when ground with linseed oil, forms the white lead of commerce. When it is subjected to the above treatment the oil is first burned off, then at a certain degree of heat, the oxygen and carbonic acid are set free, leaving only the metallic lead from which it was manufactured. If, however, there be present in the sample any of the above-mentioned adulterations, they cannot, of course, be reduced to metallic lead, and cannot be reduced by any heat of the blow-pipe flame to their own metallic base, and being intimately incorporated with the carbonate of lead, they prevent it from being reduced.

The Chalking of White Lead Paint

Just why white lead chalks now, when it did not in former years, is a problem hard to solve. The matter has been thoroughly discussed, by painter and paint maker, also by white lead makers. Perhaps the trouble comes from insufficient coats or amount of lead used, and hurried work. For it is not disputed that modern house painting is not done with the care and deliberation of former years, when work was less plenty and costs of material and labor were much less. The lead used, and probably the linseed oil used now, are as good as ever they were. It must be then that we are not proper workmen.

Two-coat work is universal now, where three used to be the limit for average good work. We don't brush out paint properly, as we used to do, nor rub it in well. We apply two heavy coats, where we used to apply three medium thin coats. A well-painted house used to look well-painted for upwards of 15 to 20 years; now it needs re-painting in three years or even less. A white lead maker says the trouble is with the painter not getting enough oil in his paint. He thinks that by mixing the paint to the proper consistency and leaving it stand 48 hours, then adding more oil to it, we shall get the proper amount of oil in it to insure durability. There is no doubt that too little oil in white lead paint will result in poor service. Also that three thin coats, containing a proportionately larger amount of oil than heavier paint contains, will give better service than paint applied in heavy coats, which lack oil to make them thinner. Then it must be remembered that the surface that is painted may absorb some of the oil from the first, and even from the second coat; in this case chalking is sure to result. In fine, until the oil leaves the lead pigment chalking cannot occur.

It is plain then that what is required is that paint intended for the first and last coat should contain plenty of linseed oil.

"Unless the surface to be painted is very dark, a thin coat, long in oil, and a medium heavy second coating will give just as satisfactory a result, and far greater durability, as two very heavy coatings. If the surface is very dark, or very porous, three coats are necessary, that you may get the necessary hiding power without sacrificing the necessary linseed oil.

"It is strange, yet true, that, with high-class painters, those jobs go wrong on which the painter earnestly strives to do his best work, and when, as a rule, no price is asked, and the cause is almost invariably that in trying to do his best work, he does his worst, inasmuch as he puts too much lead value on to his work, rather than too much linseed oil value.

"Linseed oil is cheaper than white lead. Take 100 lbs. white lead of best grade ground in pure raw linseed oil, and which bulks 2 8/10 gals., and 5½ gals. of thinners, the whole amounting to 8¼ gals. of paint. Say the white lead costs $8.00 per 100 lbs., and bulking 2 8/10 gals. as stated, the actual cost of a gallon of the thick white lead in oil by itself is $2.85, before being thinned for use. Therefore, linseed oil, at $1.25 a gallon, costs less than half of the bulk cost of thick white lead in oil, and the more oil you use the more economical and desirable the paint."

This is the argument of a large white lead manufacturer, and while it may sound as if he would boost oil and put a damper on the use of white lead, yet it is clear, or should be, to any one, that what he wants to impress upon us is, that white lead will have its proper recognition as a paint base if it can be shown that chalking is not an inherent fault of the lead. He further argues that the fact that there is a chemical compound formed when white lead and linseed oil are mixed, yet the fact has little if anything to do with its chalking. Here it might be said that some chemists say that this chemical action results in soap making, something akin to what we see when we add lye to fat. Becoming soap, the paint is easily acted upon by the weather, and soon chalks. This our white lead manufacturer disputes; not that the soap does not occur, but that if it were true, then "the paint mass would disintegrate as a whole, where as a matter of fact, the paint mass does not disintegrate at all."

"The only action is, that light, heat, rain, etc., disintegrate the linseed oil of the paint mass, on the exposed surface, and the moment the oil is gone, the lead becomes 'chalky.' There is nothing to bind it, and the above contention is proven, inasmuch as the remainder of the paint mass remains absolutely unaffected.

"Of course, as successive exposures of surface are attacked in turn, the linseed oil becomes disintegrated gradually, until the oil has entirely disappeared, and leaving no binder to the surface to hold the lead, it all 'chalks' off in time, but the time required is several years if the proper amount of linseed oil has been used."

Now, coming back to the matter of lead soap. White lead and linseed oil form a certain kind of soap, as previously stated, but this lead soap is claimed by our white lead man to be insoluble in water. If this is true, then it is not the kind of soap we are familiar with. Indeed, it cannot be soap at all, or, at most, has few attributes that are found in common with soaps.

It is also said by some authorities that hydrate of lead, which is a component part of all Dutch process leads, "eats up" the oil and causes chalking, but this our white lead man denies, and he adds:

"As evidenced, note the report of the fence tests, proving that oxysulphates of lead, made by the heat process, and other soft-drying paint pigments, none of which contain a particle of lead hydrates, show as great, if not greater chalking propensity than the hydrocarbonate of lead itself."

Finally, and to sum up, it is probable at least that if we get back to the old-time practice of using plenty of oil with our lead, apply thin coats and enough of them, getting and using good materials, we shall have no further difficulty with our paint made of white lead and oil chalking. Of course, there are many factors entering into the problem of good painting, such as present day lumber, for example, and the possibility of bad oil, but, with care and the getting of as good materials as we can, our painting will compare very favorably with that done two generations ago.

OXIDE OF ZINC—ZINC WHITE

UNDER the head of "Pigments Used by Painters" a brief description is given of the processes for making zinc oxides. In this place will be given more attention to the pigment as a paint material.

There are marked differences in the quality of zinc paints, just as in other products in the paint trade. First in importance is selection. Look to fineness of grinding, color, opacity, and capacity to mix readily with thinners. These are all properties which can be readily determined and compared by careful examination of the sample alongside a previously selected standard. Inferior zinc paints will always compare unfavorably in regard to one or probably several of these points. Thus bad color and "grayness" may be masked by the addition of blue, a sophistication which can easily be detected. Again, inferior grades of oxide zinc are transparent, or in other words, possess low opacity. The addition of barytes as an adulterant to the paints causes the same fault. It should be noted in this connection that certain zinc pigments contain barium sulphate as an essential part of their composition. This material differs in its physical properties from the native barytes, so that the mere presence of barium sulphate in a white zinc paint does not condemn that paint, as can be proved by accurately determining the opacity-figure of pure sulphide zinc white of a reliable brand, and comparing it with that of white lead. To prevent all ambiguity on this point, however, it is preferable to divide zinc white paints into oxide of zinc paints (which should always be absolutely genuine) and sulphide zinc paints (the pigment in which should contain not less than 30 per cent. of true zinc sulphide).

Fineness of grinding is a point which should always be looked closely into by the painter, as some paint grinders are very careless on this score. Zinc paints are by no means easy to grind with oil, and there is occasionally a temptation to gloss over any little imperfection in the grinding by the addition of pale boiled oil or an artificially prepared thickened linseed oil. The painter can always detect such dodges by thinning the paint out with pure turpentine and painting a glass slip with the mixture by means of a clean camel's-hair brush.

The variations in the ease with which the different zinc paints "take the thinners" is remarkable. A well-ground sample of zinc white of good quality ought to be no more difficult to mix with the thinners than good white lead. Occasionally, however, one finds a zinc white paint which is stringy and ropy, and this is a serious defect.

The conclusion I have come to, after examination of a very large number of samples of zinc paints, is that although paint grinders may for reasons of their own sometimes employ pale boiled or thickened oils in the grinding of white zinc paints, the painter is best served when his stiff paint—the base to which he has to add his thinners—contains no vehicle but pure, refined linseed oil.

The question of the proper consistency of the stiff paint is so well understood on the Continent, where zinc paints are handled every day by painters, that on large contracts architects and engineers are in the habit of specifying the exact composition of the stiff paint. Thus, a certain large industrial undertaking in Belgium using quantities of zinc paints, has its ground zinc white of the following composition: Oxide of zinc in powder, 666 parts by weight; linseed oil, 334 parts by weight.

In another case the stiff zinc paint (oxide of zinc) is specified to contain 20 per cent. of linseed oil. Paint of this composition is readily mixed with oil or turpentine. It is a great mistake to grind zinc paints too stiff. If the paint is too viscous on the rollers of the grinding mill it is readily overheated and burned, and this at once ruins the paint.

Thinning Zinc Paints.—This process is a vital one, and deserves special attention from those who wish to obtain the most satisfactory results. It is best carried out by mixing the thinners and driers together first of all, and then adding the mixture to the stiff paint. By proceeding in this way, uniform results are much more likely to be obtained. The first thing to do is to fix once and for all the relative proportion of oil and turps that should be used for different kinds of work. The following are proportions which have worked out practically and which may be adopted:

	1	2	3
Refined linseed oil......	11 pints	12 pints	4 pints
Turpentine	3 pints	4 pints	24 pints
Varnish	1 pint	1 pint	1 pint

No. 1 is suitable for exterior work. The varnish should be a good outside varnish. For finishing coats, where the maximum of durability is desired, pale boiled oil may be substituted for refined linseed oil, and the proportion of turpentine reduced to two pints, one pint, or even less.

No. 2 indicates a mixing suitable for a glossy finish in interior work. Here the varnish should be a hard-drying interior varnish.

No. 3 is suitable for flatting or undercoat for enamel. In this case either a flat mixing varnish or gold size should be used.

There are three practical points worthy of attention in connection with the mixing of zinc paints. They are:

(1) Do not use too large a proportion of turpentine. (This does not, of course, apply to flatting.)

(2) Keep the paint "round"; the best zinc paints are those that are somewhat viscous, and they brush out, as a rule, quite easily.

(3) Do not try to force the drying unduly. The drying of all paints depends on the action of the air on the drying oil. Driers are therefore at the best an artificial aid to drying. The most durable paints are those in which the drying proceeds slowly, naturally and regularly.

Driers for Zinc Paints.—This question is a vital one, and deserves special attention from those who wish to obtain the most satisfactory results. The old-fashioned paste or patent driers are most decidedly not the most satisfactory driers for zinc paints, and as this question is continually cropping up, and painters frequently find that driers are the stumbling block when zinc paints are in question, I may be allowed to digress for a moment to indicate why paste driers are not, as a rule, successful in zinc paints.

White lead is itself a "drier," and consequently the addition of more drier results in a strong drying action rapidly setting in. When this drying action goes too far, as it often does, the oil gets burnt up and the paint powders and perishes. This phenomenon is often seen in old white lead paint. Now in the case of zinc white paints, which are absolutely inert so far as drying action is concerned, the drier (whatever it be) must first be brought into solution in the oil before it can exert any drying action. Paste driers in which the drying material is mainly in the solid state, take some time to dissolve in the oil contained in the mixed paint, and there being nothing present of a gentle drying nature, like white lead, to start the drying off, so to speak, the action takes some time to begin. This constitutes a danger, as the ignorant man then adds more driers, until there is a huge excess of drying matter present, resulting in serious damage to the life of the paint.

The use of liquid driers is preferable. In these driers the drying matter is already in the liquid state, and is therefore in a condition in which it can much more quickly and effectively enable the drying process to commence. Further, liquid driers, when of good quality and used in strict moderation, contain nothing injurious to the paint. The true rôle of a paint drier is often misunderstood. It is to start the absorption of oxygen by the drying oil, and to keep the absorption going regularly and moderately. If this is done, a tough, durable film is obtained. Nature has been assisted to do her work. If too much drier has been used the oil will have been superoxidized, with the result that a brittle, easily-destroyed oil film has been produced.

Mixing and Application.—To secure the full intrinsic value of zinc oxide paint it should be applied exactly as a good painter would do it, namely, in two or three or more coats, for it is a pigment that does not permit of making one coat do the work of two.

Zinc paint should be mixed rather stout but be rubbed out thin; if mixed thin it will run and not cover properly. Properly mixed, it has been found that three coats will cover as much surface as three coats of white lead paint, and cover the surface just as well.

In mixing zinc paint there should be used a suitably prepared linseed oil, and should contain very little turpentine. Being a poor drier, it should be well assisted with driers. The addition of a little varnish in outside zinc paint is advised.

When used for making a flat or dead finish, it must be remembered that zinc white ground in oil contains a larger percentage of oil than white lead, as it takes up much more. This oil must be removed with washes of benzine, in the usual manner; after which the pasty residue may be mixed with turpentine and a good flat paint result. Zinc white contains about 20 per cent. oil in the paste form, while white lead contains only about 8 per cent.

Some painters advocate zinc for priming coats on wood, but this may seriously be combated, white lead being in every respect the best pigment material for that purpose.

The priming coat being white lead, then let the next two, say, be zinc and lead paint. Or three coats of zinc may be used, according to the quality of the work. Let each coat be mixed somewhat different from its neighbor coat. Do this by varying the quantity of oil, etc. This is the rule in all good painting.

Pale boiled linseed oil is a good medium for thinning white zinc paints, but boiled oil is always difficult of admixture with zinc, when the mixing is done with a paddle; with machinery, as in the paint factory, the case is different. Yet if a pale drying oil can be used for thinning zinc paint it will be found very much better than ordinary raw oil.

For many purposes the oxide of zinc as ground already contains sufficient oil, and only needs to be thinned down to the proper consistency with turpentine.

For painting on a non-porous surface, like iron, for instance, no oil need be added, and a beautiful white enamel surface will ensue, with an egg-shell gloss. The 20 per cent. of oil in the zinc paste will be quite enough to give this effect. Most of the troubles with paint come from bad oil, which is the most important factor of the two, oil and base.

Out of the mass of controversial matter respecting the merits of white lead and zinc for exterior painting it is well to avoid extremes in either direction. A combination of these two important pigments has proven its worth, consisting of three parts of pure white lead in oil and one part zinc. In this proportion the zinc holds the lead from chalking and the lead holds the zinc from chipping and fissuring. Mix the pigments separately in the proper liquids, and at the right consistency pour together and stir until a complete incorporation of the two bodies is obtained. Used in coats, above the priming, this combination is rewarding the user with very durable results in both eastern and western sections of the country.

Footnotes on Zinc White

The presence of a yellow tint indicates traces of cadmium sulphide.

Zinc white should be kept in zinc tins or in tinned iron vessels.

Don't cover with water, which hardens the zinc; cover with oil only.

Pure zinc white has great spreading capacity, but poor covering power.

Zinc white is prepared from the pure metal zinc, this being the best; it is also prepared from zinc ore, which is the kind mostly used by our painters.

To test zinc white for purity take it dry and heat it; when cool it should be of original whiteness.

Boiled in dilute muriatic acid it should dissolve completely without effervescence.

To test zinc white ground in oil wash out the oil with gasoline, dry the pigment, then test as above.

Leaded zinc white contains some lead sulphate. The lead is not added direct but is due to the method of production. In small amount the lead does not injure the quality, but rather tends to improve it.

The lower grades of zinc white have poorer covering capacity than the best grade.

Zinc white is easily adulterated, much more so than white lead, so as to escape detection. This is why some zinc whites are not satisfactory.

Sulphureted hydrogen, if it has any action on zinc white at all, does not injure it, nor when it is tinted, at least not to any appreciable extent. If sulphureted hydrogen affects the zinc at all it is merely to form zinc sulphide, which is itself white.

Zinc white being an artificial product, its composition varies, the best grades approximating 10% zinc oxide, while some of the cheaper products contain more or less lead compounds, either as sulphates or oxides, and possibly sulphate of zinc, which is considered harmful, as it is soluble in water and is liable to make paint streak. It is said that zinc oxide is rarely adulterated.

To make a lead and zinc compound paint do not mix the two together, but in separate pots, then box the two together.

Zinc white paint must not be mixed thin, owing to its lack of body; mix rather stiffish.

For exterior painting mix with pale boiled oil, and use rather stouter than you would white lead. But either inside or outside this stout paint should be rubbed out some, enough to cover well.

By mixing the paint the day before using it will be found to work easier under the brush and cover better.

The putty used on zinc-white work should be made from zinc and whiting, first passing the whiting through a sieve to remove particles.

PIGMENTS USED BY PAINTERS

Purity of tone is the first important quality of a pigment, and fineness of grinding next in importance. For comparison it is well to have tubes of artists' colors on hand, for these are the very best that can be produced. Compare for purity of tone, fineness of grinding, and for tinting strength. By rubbing some of the pigment between the thumb and finger or placing some on the thumb nail and rubbing it with the other thumb nail any grit may easily be detected, and grit would prove coarse grinding. Or place some pigment on a piece of glass and rub it with another piece of glass. Or rub some with the spatula. Hold the glass up to the light and see whether the pigment has made scratches.

For tinting strength mix a little of the color with zinc white; observe depth and clearness of tint given. Test dry color for fineness of grinding and presence of make-weights by placing in a tube with 2/3 water and shake; pour off the water before the pigment has entirely settled; repeat until the residue has been obtained. Allow this to dry, then examine for granular impurities.

Umber.—The best grade is Turkey umber, and it has a warm, violet-brown color, inferior umbers having a rather yellowish tone. Raw umber is greatly improved in color by being calcined. Raw umber is little used by painters, but the burnt umber is much used, for, with lead or zinc-white, it gives very pleasing shades; alone, it is useful in stains and for graining purposes. Used as a body color it is very liable to fade or grow rusty-looking.

Umber is a transparent color, which makes it so desirable for staining, glazing and graining. An imitation umber can be made by properly mixing red, yellow and black, but it would not be transparent, though for many purposes it would do very well.

Vandyke Brown.—This is an earth pigment, probably the result of the decomposition of lignite or brown coal. It is blackish-brown in color, smooth and very light. It is also a very durable pigment, quite transparent, but of little use to the house painter. But it is useful in graining. With lead or zinc-white it gives muddy tones. There are several varieties of Vandyke brown, all stable pigments, and neutral with other pigments.

Yellow Ocher.—The best grade is that known as French yellow ocher. Compare some French ocher with American ocher, and you will perceive quite a difference of tone, the former being yellow, the latter reddish. And though inferior to the French, the American ocher of the best grade has three times the tinting strength of the French; mixed with white lead it gives a dull tone, the French a clear, bright tone. The chief difference between the two ochers is that the French has a silicate base, and the American a clay base; as clay absorbs water readily it will be seen that the ocher having it as a base will not answer well as a paint. When used for priming the clay ocher absorbs moisture and the paint comes off.

The best brands of French ocher are valued according to their uniform bright yellow color. The U. S. Government requires in its specifications for French ocher at least 20% of iron oxide, and not more than 5% of lime in any form. The different brands of French ocher are designated by certain letters, which signify their color tone, etc. Thus, J, yellow; F, dark; L, levigated; S, superfine; E, extra, or superior, and C, pale or light. So, for instance, J. F. S. means yellow dark levigated extra superfine. J. F. means dark yellow. J. T. L. means dark yellow washed ocher. J. C. L. S. means citron yellow washed superfine. J. O. L. S. means yellow golden washed superfine, the O standing for gold, and all the letters are the first in the French name for the color or condition. Thus R is from rouge, red. R. L. S. means dark red washed superfine.

Golden Ocher.—There is a golden ocher made from yellow ocher and chrome yellow, but this is not the true golden ocher, which is made in the factory from a formula as follows:

Barytes	550 lbs.
Best American ocher	230 lbs.
Nitrate of lead	29 lbs.
Bichromate of potash	15 lbs.
Glauber salts	15 lbs.
Sal soda	6 lbs.

This formula produces an ordinary lead chrome thrown down on a base consisting of barytes and ocher. The process is given here that the painter may have an intelligent idea of what golden ocher is.

Sienna.—Properly speaking, sienna is simply a yellow ocher of a deeper or browner color. Some writers class both under the head of ocher. They consist essentially of an earthy base colored by oxide of iron, or maganese, or both. A good grade of sienna should show very little grit under the palette knife, and it should have good tinting strength, which may easily be tested by coloring some white lead with it. It is a transparent color, or should be, at its best, and this may be tested by using it as a glaze over some graining ground. Raw sienna is much lighter of color than the calcined or burnt sienna, the latter being quite red. Both raw and burnt are very useful to the painter and grainer. The raw with white lead makes a good graining ground for oak, and also for making the oak graining color, with the addition of a little black or burnt umber. The burnt sienna makes a fine stain for cherry, etc., and for graining color. The Italian sienna is the best.

Yellow.—The most important yellow used by the house painter is chrome yellow, or chromate of lead. There are several shades, ranging from a pale lemon yellow to a decidedly red-orange. The lighter shades usually contain some lead sulphate, as well as lead chromate, while the deep orange yellow contains some basic lead chromate. Pure chrome yellow should contain only lead chromate, lead sulphate, and possibly some basic lead in the deeper shades. A chrome yellow should be considered adulterated if it contains anything besides insoluble lead compounds.

Chrome yellow is often adulterated with barytes or whiting, as well as with lead sulphate. No matter how made, pure chrome yellow always has an orange-yellow color. But color makers produce several shades, from the orange to the pale yellow, or the so-called lemon yellow, the light colors being impure, of course.

Zinc Chrome Yellow.—This yellow is costlier than lead chrome, but is very useful in some cases where lead chrome cannot be used at all. It is proof against sulphur, which lead is not. While it is inferior in coloring strength to lead chrome, it is more permanent to the light; is also non-poisonous.

While lead chromes vary in color, it is practically impossible to produce any variation of color in zinc chrome.

Genuine Vermilion.—This term can only be applied to the red sulphide of mercury, whose chemical symbol is HgS. Although the source or origin of the pigment may vary, true vermilion is invariably of this composition. Thus, there are the English, the French and the Chinese vermilions, and these may be made by the dry or the wet process; the composition is ever the same. English vermilion is a sulphide of mercury. It and the French and Chinese vermilions are made on this formula: 200 parts by weight of mercury or quicksilver and 32 parts by weight of sulphur, the chemical combination being sulphide of mercury.

Chinese vermilion is rather finer than the other kinds. All true vermilions should have good body, and should cover well. But unfortunately these vermilions are not fast against the light, in time altering to a dirty brown. They show no bleeding on boiling with alcohol and water, and no free sulphur by extraction with carbon disulphide. A small quantity mixed with four or five times its weight of dry carbonate of soda and heated in a tube should show globules of mercury on the cooler portions of the globe. The best test is for purity of the ash, which should not be more than one-half of one per cent.

American Vermilion.—A lead chromate base vermilion, quite permanent but a poor coverer. Usually tinted with aniline. An aniline vermilion may easily be detected by placing some of the dry pigment in the palm of the hand and note whether it leaves a pink stain. This stain is not easily washed off with water, while the reverse is true respecting true vermilion. Eosine vermilions are simply red lead, barytes, or whiting, some of these being used with red lead. The Para reds have displaced the more fugitive aniline or eosine dye, and these are quite permanent, cheap, and cover well, though not as well as the eosines. The Para reds may be classed as follows: Those containing barytes and zinc base, those containing red lead, and the Para red lakes, containing alumina, whiting, etc.

Organic lakes are now largely used in place of the true vermilion, and in making certain red colors.

Light Red.—This is simply calcined yellow ocher; it is red, permanent, and a good drying pigment.

Indian Red.—Pure Indian red consists of iron oxide almost entirely. It is one of the best covering reds we have.

Tuscan Red.—This is Indian red toned with rose pink or aniline. It loses its rich color in time, hence is undesirable unless protected with varnish, as on railway cars. Tuscan red may be adulterated as much as 64% and pass undetected.

Genuine Tuscan red is made by calcining iron oxide to a purple shade, the so-called Indian red; this is then toned up with alizarine lake, washed, dried, ground, bolted, etc., and then is ready for grinding in oil.

Imitation Tuscan red is composed of a cheap base, such as whiting or gypsum, and dyed with aniline.

Venetian Red.—This is an iron oxide and lime-base pigment. The Government specifies at least 40% sesquioxide of iron, and not more than 15% of silica, and the remainder of lime rendered incapable of taking up water of crystallization. The best grades contain sulphate of lime, and the cheaper grades carbonate of lime. The more iron oxide present the stronger the color, and, if finely ground, the greater the covering capacity. The Venetian reds are not much affected by the weather, but sometimes fade when an excess of lime carbonate (whiting) has been used in the making. The effect of sulphur fumes, smoke, etc., is to darken these reds. The best Venetian red is that made upon a gypsum base. A dry Venetian red that looks bright but dulls when mixed with oil may be classed as poor. Test in oil before buying.

Prussian Blue.—Under this name are included all ferrocyanide blues, such as Antwerp, Chinese, Turnbull's, etc. These blues are all ferric ferrocyanides, or double iron potassium salts of hydroferro-cyanic or hydroferri-cyanic acids. Prussian blue is obtained from sulphate of iron and sulphuric acid in solution, and yellow prussiate of potash in solution. It is an extremely strong color, and hence valuable in tinting or coloring. It is too transparent to use much as a body color, but it is permanent, though with a slight tendency to fade if exposed to strong light too long. Its covering power is defective, due to its transparency. Lime and alkali affect it, giving it a rusty appearance, while acids deepen its color. Mixed with zinc-white it forms a fine color and covers much better.

While these blues of the ferro-cyanide order would all analyze the same chemically, there is a physical difference in them. Prussian blue, proper, when mixed with the white pigments, produces a light blue shade, slightly purplish and grayish, while the Chinese, etc., blues of the same order give a clearer and truer shade of blue. There is also a difference of coloring power.

To the house painter Prussian blue is most useful when slightly adulterated. Ground in oil, it is apt to liver, hence should be ground in a special oil. It is a poor drier and exerts a retarding action on drying-oils. Fortunately it takes very little of this pigment to produce tints.

Celestial blue and Brunswick blue are adulterated or reduced qualities of Prussian blue; frequently they contain but 5% to 12% of Prussian blue. If barytes be taken and on it be struck Prussian blue to the extent of 12½% of the total weight of pigment a product will be obtained which, ground in oil, gives an exceedingly intense dark "Royal" blue. When so reduced the blues should be sold for what they are.

Ultramarine Blue.—This is a compound of unknown constitution, being made by heating clay, soda, sulphur, and charcoal together. It appears to be a complete silicate of aluminum and sodium. On account of the sulphide present it cannot be used with lead pigments. It is little used by the house painter, because by itself it is too bright a blue, and it does not give as clear a tint or light shade of blue on a white base as the Milori and Chinese blues. Good ultramarine blue gives little tarnish on polished copper. It may be told from Prussian blue by being dissolved in hydrochloric acid with the evolution of hydrogen sulphide.

Lime Blue.—This is simply a common grade of ultramarine blue, and is not to be used for tinting, as its color is coarse and not reliable. Ultramarine blue is not affected by alkali, lime, etc., as Prussian blue is, hence is useful for coloring whiting or lime coatings; hence the cheaper form, "Lime Blue." But sulphur affects ultramarine blue.

Chinese Blue.—A variety of Prussian blue, but has a much clearer tone and better keeping qualities. It is simply a superior grade of the Prussian blue. Any Prussian blue made from cheap grades of prussiate of potash will have a dingy color; hence a good test is clearness of color tone.

Chrome Green.—A pure chrome green should contain only Prussian blue, lead chromate, and lead sulphate. Greens made by precipitating the ingredients together are superior to those made by mixing the blue and yellow after they are precipitated separately. To distinguish the two rub some of the pigment in oil and let it stand. A badly made green will show blue, but one properly made will not. Under the microscope a poor green, dry, will show blue and yellow particles, as well as green. A well made green will show green and some blue particles, but no yellow. There is also a green made from ultramarine blue and zinc. If absolute permanence is required chromium oxide is sometimes used, but this pigment is not common. The very brilliant arsenic or copper compounds, Paris green, for instance, are very little used in paints.

For body work, or where the green is used by itself, greens containing from 70 to 95% of adulteration may be used, the covering power being little impaired, even when the amount of adulteration is up to 80%. China clay, barytes, and terra alba are the usual adulterants. The same may be said of Paris and ultramarine greens. They stand the light well, but are affected by lime, which turns the green a rusty orange color.

Paris Green, or Emerald Green.—Once much in use for painting Venetian blinds, etc. Being extremely poisonous, chrome green was made to take its place. It is sometimes added to chrome green to enliven the latter. But Paris or Emerald green has very poor covering power.

Ultramarine Green.—This is very seldom used by the house painter, though much used by the interior decorator or fresco artist. It is a very transparent color.

Lampblack.—Black pigments are practically all carbon blacks, in one form or another. Lampblack is a finely divided carbon, obtained by collecting the smoke produced by burning oils, with the admittance of air sufficiently reduced to prevent perfect combustion, the object being to consume all constituents of the burning body but the carbon, and to preserve as much of that as possible.

Natural gas lampblack is free from mineral impurities and unburned oil, and has a full black color. It is a very fine and durable black pigment.

Pure lampblack is a permanent color, and very durable. Will last longer in the weather, against heat or cold, rain or shine, than any other pigment or combination of pigments. It is a very slow drier, yet dries within a reasonable time. The addition of a little Prussian blue helps its drying and does not affect its tone. In fact, will make it blacker. It is naturally so fine that grinding makes it no finer. It is sometimes added to other blacks to improve fineness and durability.

Blacks, alike chemically, may behave very differently when ground in thin varnish. For example, lampblack mixed with such a varnish in a ratio of 20 to 100 has flow, while gas black, similarly treated, has no flow.

The blacks are often adulterated; lampblack will stand as much as 50% adulteration with whiting or barytes and yet look black. For tinting purposes such a lampblack answers better than the pure grade, but the price should be much lower.

As a rule the lighter and bulkier the lampblack (that is to say, the smaller the amount that can be packed in a given space) the greater the amount of oil it will absorb, and the greater its tinting strength, regardless of tone, pound for pound. Two dry blacks of equal strength, one requiring the most oil in grinding, will show a good test. The one requiring the most oil will produce the weakest color in oil, while a more expensive and stronger black, absorbing a larger amount of oil, may produce a paste both stronger and cheaper. Thus we see that there is more in the selection of lampblack than mere strength alone.

To test lampblack place some on a tin lid and hold it over a flame for a few minutes, when the remaining powder will show all the characteristics of lampblack, namely, a powder perfectly smooth under the palette knife, and black in color. Pure gas black after burning will show a slightly gritty residue, of a brownish-black shade, caused by the drying material ground with it. With an adulteration of 50% barytes lampblack will show a residue of white, with streaks of uncalcined lampblack. Gas black with 50% whiting will show a residue of dirty white color, with brown-black streaks of uncalcined material.

Drop Black.—Ivory drop black should be made from calcined ivory, but seldom is. It has a rich, velvety black color, while bone black has a reddish cast. Bone black is called ivory black. The name "drop" comes from the manner of making it; the dry powder is mixed with a little glue size and is allowed to fall in the form of cone-shaped drops, which are then dried and sold to color grinders. Pure ivory drop black will resist sunlight better than any other black excepting, perhaps, lampblack. It is considered to be one of the most permanent of the blacks. In making tints of gray with black, remember that lampblack and drop black make different tints, the latter making a softer tint, the former a colder gray. A little burnt umber is good in making a gray tint with black.

Inert Pigments.—When oil is mixed with the chemical pigments, such as lead, zinc, yellow chrome, Prussian blue, etc., there is a chemical union, and chemical reactions occur between the oil and the pigment, to the injury of the paint.

When the earth pigments, the ochers, siennas, umbers, etc., are mixed with oil there is a mechanical union, like the mixing of sand and water; there is no chemical union or reaction. Hence we call such pigments inert, and to this class belong barytes, silica, terra alba, etc. When inert pigments are added to chemical pigments there is an absence of chemical reaction, to a very large extent, at least. The various substances used as inert additions to paint are barytes, whiting, gypsum, kaolin, pulverized silica, soapstone and ground feldspar. Gypsum is probably the best to use with pigments. It is of great durability, chemically inactive as a pigment, of low specific gravity, and can easily be ground and incorporated with pigments or paints, and does not settle rapidly in the paint pot. But should water get into the paint mixed with gypsum it is apt to liver up.

Zinc White or Zinc Oxide.—There are two methods of making this excellent pigment, the French and the American. Briefly the former consists in preparing it from the pure zinc metal known as spelter; the other way is to treat the ore. The French process naturally gives the finer article, one that is of the utmost whiteness; the American process zinc white is somewhat harsher of texture and not so white. Chinese white is only another name for the French process zinc white. French zinc is particularly useful for the artist and the interior decorator, while the American process zinc white is very good for outside painting. Some Western brands of zinc white contain a small percentage of lead sulphate, but this is not considered to be in any way harmful to a paint made from it, either for exterior or interior work.

Chremnitz, Chinese and Florence White.—The first named white is the best selected white lead ground in damar varnish. Chinese white is a fancy name for zinc oxide white. Florence white, sold in paste and liquid form, is French process zinc white, ground in damar varnish.

Lithopone.—A white powder resembling zinc white in appearance, but of heavier gravity and not as great an absorber of oil. There are several grades, sold as red, white, blue, green and yellow seal. The green seal brand is regarded as being the best; it consists of zinc sulphide, 30 per cent.; zinc oxide, 2 per cent., and barytes, 68 per cent. The other grades range from 26 per cent. zinc sulphide to about 14 per cent. If you will drop a little diluted hydrochloric acid on some zinc white there will be no result. But drop it on lithopone and you get the odor of a burning match, or sulphureted hydrogen. It will also effervesce. Lithopone has good covering power, spreading well, but is not to be used in connection with white lead, which it discolors. Of itself it is a very permanent pigment, being unaffected by sulphur gases or other gases that are baneful to many other pigments. Its greatest use as regards house painting is in wall paints, a subject treated in full in another part of this work. It has long been used as a paint by oil cloth makers.

White Lead.—Corroded lead, basic lead carbonate. May be made by several different methods. Is an amorphous white powder, with little affinity for linseed oil, an elastic base, and the best for all general paint purposes. Should be white, fine, and of good covering power. A yellow tone indicates overheating while grinding. Of a pink cast, contains some red lead. A grayish tone indicates the presence of uncorroded lead.

Sublimed Lead or Basic Lead Sulphate.—It is made by burning lead ore that contains some zinc and which cannot be entirely removed. There is found usually about 90 per cent. lead sulphate and 10 per cent. zinc oxide in its average composition. It has a harsh texture, and is not as elastic as the best white lead, nor has it as good a covering power. It does not flow well under the brush, nor make a nice, level surface. Exposed to sulphur gases, it will not darken as white lead does. The addition of a small percentage of Paris whiting is said to greatly improve its texture. In fine, it has so many objectionable qualities that it cannot be said that it is a useful pigment for the house painter. It does not present any advantages that white lead does not offer, while its merits are few. Under the blow pipe it is difficult of reduction and can only be reduced when fused with powdered borax, and even then with difficulty. Its critics say of it that it lacks body, becomes brittle, and cracks.

Zinc Lead.—This rather modern paint base, used mostly by paint manufacturers, is composed of about equal parts of lead sulphate and zinc oxide, and is derived from an ore containing lead and zinc. The method of making this pigment is similar to that employed in making sublimed lead. Possessing a good body, yet it does not work as well under the brush as a mixture of lead and zinc in equal parts. It has a harsh texture, more than that of sublimed lead, and its color is poor. It, however, carries more oil than either white lead or sublimed lead, by about 20 per cent. Used by itself on exterior work, it shows a tendency to crack.

Sulphate of lead, largely used in some ready made paints, lacks covering power, a fault that may be overcome by the addition of borax, it is said. Lead sulphate is not poisonous, nor is borax.

Steatite.—The mineral steatite is better known to the public as soapstone, talc or talcum. It is a composition of magnesium oxide and silica, combined with a certain percentage of water. Most people are familiar with the substance, and will recall its soapy feel. But there are several varieties, and several colors, such as white, cream, gray and pale apple green.

To the variety which is scientifically described as foliaceous, or micaceous, is given the name of talc. To the compact, cryptocrystalline to coarsely granular forms is given the name steatic. To the dark gray and greenish talcose rocks, which are soft enough to be cut by a knife, and which have the peculiar soapy feel, is given the name soapstone. The pure creamy white talc is used for making crayons and slate pencils. French chalk, used by tailors, and often mentioned by sign painters as useful for outlining letters on glass, is a very fine talc, obtained from abroad; most, if not all of what we use, being quarried in our own country. The fibrous and granular talcs are used for a number of purposes. One very near relation of talc is meerschaum, the chemical formulas of the two being very alike, both being composed of magnesium oxide and silica, with a little water. Soapstone in powdered form is used in quite a number of special paints, but is too transparent in oil to be used as a base. Its chief value lies in its property of giving a glaze or polish to a painted surface, to its fireproof character, and its voluminous nature.

Whiting.—Whiting is made from natural chalk rock, which is crushed to a coarse powder, then is ground under water to a fine pulp, after which it is ground in another kind of mill, and made into a moist cream. Then the cream is run into a large tank of water, where it is stirred, and after a time it is allowed to settle, the coarser parts going to the bottom, and the liquid part is drawn off into another tank, from whence it is run into a still smaller tank, each time losing something of its coarseness. This washing process is called "levigation." By this system of "floating" the whiting in water the last tank will contain the finest whiting, and the different tanks will yield different grades of whiting. The whiting is now taken from the tanks in a moist mass and dried in a "stove room." The whiting may be sold in this lump form. When molded in cylinder form it is called Spanish white. This hard lump whiting must be ground in mills before it is fit for the decorator's use —ground, then sifted through what is called "bolting cloth," a fine-meshed textile material used also by millers of flour. The resultant whiting is known as bolted whiting. But much of the "bolted" whiting on the market is really "air floated" whiting, a much finer substance.

When the whiting settles in the tanks the coarsest part goes to the bottom, the next coarsest part forms a layer upon the first, and so on, the top layer being the lightest and finest. This top layer is known as Paris white, the layer below is called "gilders' whiting," and the bottom layer is sold as "commercial" whiting, it being used mostly in the manufacture of putty.

The name of whiting in chemistry is *calcium carbonate,* meaning carbonate of lime.

While whiting is usually classed among the inert pigments by paint men, yet it is well known as a form of lime; being a carbonate of lime, it must form a lime soap by reason of a chemical reaction between it and the oil in paint. Such a paint, that is, whiting in oil, or a paint in which whiting may largely figure, cannot be considered a durable one. Yet we have the evidence of great durability in the well-known form of putty, which, when properly made, becomes hard as stone, and does not soon decay. Also we know that a white paint containing some whiting with lead, was formerly used for years, and with the best results, on river boats. At any rate, whiting is one of the most indispensable materials we use.

The different grades of whiting vary in weight, the best being finest of texture, weigh less, or are bulkier. Thus, a gallon of precipitated chalk, the finest form of chalk or whiting, weighs a little less than 3 lbs., while a gallon of Paris white weighs a little more than 7 lbs. A gallon of gilders' bolted whiting weighs nearly 6 lbs.

Barytes.—Certainly if ever paint makers get to worshiping graven images they should carve them out of the mineral barytes, for it has been their most useful agent in connection with the manufacture of paint and colors. Not that the use thereof has always been wrong, for as an extender or necessary filler, barytes has its use. But many a ton of it, costing, say, $20 a ton, has gone into paint shops at anywhere from $100 a ton upwards, in the form of so-called white lead, paint and colors. To-day comparatively little of this shameful adulteration is done, and when barytes is used in paints or color, some excuse is generally made for its presence. That it is a valuable addition in many cases there can be no doubt, but as an adulterant it is always wrong.

Given two samples of a white powder, one of which is dry white lead, the other dry barytes, and asked to tell the two apart, you could not do it; they are equally white, equally fine, equally heavy. But rub up some of each in oil, and at once the difference is apparent, the white lead continuing white, the barytes looking like putty.

Being exceedingly fine of texture, free from color, and inert, it has paint virtues of a high order. It takes stains uniformly, and to make a small quantity of color, aniline, for instance, cover much surface, it is very useful; it is, in consequence, used as a base for conveying many organic coloring matters that are used in paints.

In the paint shop barytes has no place, whiting being the more useful inert material to the painter.

DRIERS USED IN LINSEED OIL PAINTS

Driers for linseed oil may be conveniently divided into two classes, oil driers and resin driers. The latter are commonly known as japans. Of the two classes there are numerous varieties, differing in color, consistency, and ability to dry linseed oil. The function of a drier in an oil paint is to absorb oxygen rapidly and convert the film into a hard, insoluble product. The linseed oil during this process is changed into linoxyn. However, the action of the drier does not stop here, but continues its oxidation until the paint film is eventually destroyed.

Oil driers are made in this manner: A certain amount of linseed oil is put into a kettle and heated. Drying salts are added, usually salts of lead and manganese, and the oil run up about 500° F. In running the oil up to this temperature it gathers considerable head and must be whipped down. The temperature is allowed to drop, and turpentine, or a mixture of turpentine and benzine, added.

Resin driers are made in much the same manner, except that resin is used in place of linseed oil.

Of these two classes oil driers are to be preferred, because they exert a less harmful action on the paint film.

The drying salts used in the manufacture of driers are quite numerous, but those which find the widest application are salts of lead, manganese and cobalt. Only recently have cobalt salts come into favor, and it is claimed they are less harmful in their action.

They affect the color of the oil only slightly. We must not overlook the properties of the thinning medium as a drier. When turpentine alone is used, it adds to the drying power, but when benzine is used it exerts no such influence.

Temperature and humidity are important factors in influencing the rate of drying. As a general rule, the higher the temperature the more rapid is the drying, and the lower the temperature, the slower the drying. Humidity seems to exert less influence than temperature.

Some pigments influence the rate of drying quite considerably. Thus, lampblack dries very slowly. This effect has been attributed to oil which it contains, but tests made from lampblack containing absolutely no oil give the same results. I am inclined to believe that this phenomenon is due to the physical properties of lampblack, and that owing to its extreme fineness a lampblack film cannot breathe with the same facility as an ordinary film. We know that a paint film made from linseed oil and lampblack is very durable, and this durability is no doubt due to the inertness of the lampblack, and that it has no oxidizing influence on the oil. On the other hand, lead compounds, such as white lead and red lead, do have an influence on the oil, so that the chalking of white lead may be due in a measure to the fact that white lead itself exerts a drying action. Certain lakes and aniline colors are affected by driers. In some cases the shade is affected to a considerable degree, due to the influence of the metallic salts in the drier. The bleeding of Para reds has been attributed to the destructive influence of driers.

The abuse of driers seems to be the use of more than the requisite amount necessary to dry the paint film. If the drier used were an oil drier, the effect would not be so serious, but would result in the film not having the usual gloss. If, however, the drier were a resin drier, the paint film at first would have a very high gloss, but cracking would probably be the final result.

Strange as it may seem, the use of too much drier prevents drying. Hard, insoluble linoxyn is either not formed, or is dissolved by substances formed by secondary chemical reactions, so that the film remains tacky.

New linseed oil, or oil which is not well settled, affects the drying. A well settled, aged oil will dry more rapidly than one freshly made, for the latter contains mucilaginous matter, which settles out with age.

I believe that the more knowledge a painter has of the material he uses the better are the results he will obtain, and the wider application he will find for the material. Now, applying this to driers, if he had some definite knowledge of the strength of a drier, say it was one-to-twenty drier, that is, that under ordinary conditions, one part of the drier would dry to the touch twenty parts of linseed oil in twelve hours, he would know just how much to use and he would know just what result to expect.

Coach japan, oil driers and liquid driers are the vehicles most used in house paints and are subject to more abuse than all other liquids together.

Coach japans usually contain a gum (Kauri, Manila, or rosin) and are designed for paint which is meant to dry exceedingly hard. Oil driers are generally made without gum and consist of a lead and manganese treated oil reduced with turpentine or benzine. The liquid driers are simply a gum or oil drier still further reduced with turpentine or benzine.

The great abuse of driers is in using too much, the result being that the paint is literally burned up by oxidation. If there was some standard for the strength of the different driers or japans, there would be less trouble, but as it is now, every painter is obliged to try out each new brand in order to determine how much to use.

The manufacturer generally advocates the use of 3 per cent. as a maximum, knowing that this amount is practically safe, but 3 per cent. or 1-32 of a gallon of drier to one gallon of mixed paint will produce results depending upon the strength and not the quantity of drier.

A simple method of determining the strength of a drier consists in mixing one fluid ounce of the drier with one quart of raw linseed oil, flowing on glass, standing upright, and noting the time it takes to dry. Comparison should be made with standard samples or previous shipments under similar conditions. The mere drying of the japan itself on glass is no criterion, as "crusher's drier," which dries oil rapidly, does not dry by itself in many hours.

Where a 3 per cent. mixture of concentrated oil drier gives the required result, it is often necessary to add 33 per cent. or more of a cheap liquid drier to produce the same effect.

Under ordinary conditions raw linseed oil will dry in about three or four days, so that if we have made a paint consisting only of raw linseed oil and a pigment and applied it to a surface it would take so long to dry that the dust and dirt of the atmosphere would collect on the freshly painted surface and spoil its appearance when it finally dried. To overcome this slow drying of raw linseed oil we add driers.

Pale liquid driers are very light of color, and stain very little in white paint, but they are not a strong drier, it requiring more heat to make a strong drier than is used with the white or pale drier, and the heating darkens the drier.

Oil driers should not contain any gums, rosins, etc., being principally linseed oil with siccative properties; it is best for exterior oil painting, as it is less liable to crack, etc., being more elastic. But they are slower than the japan driers, which ought to be preferred whenever quick drying of the paint is desired. Boiled oil may be considered an oil drier, because when mixed with paint it renders the use of any other driers unnecessary. Flat or semi-flat painting requires quick drying, hence the stronger japan driers are indicated.

Paste or patent driers are made in paste form from barytes, white lead, zinc sulphate, acetate of lead, and boiled oil, all in definite proportions.

There are many formulas for making driers for paints, and of course many qualities, as well as kinds for distinct purposes. Care should be observed when using, testing a sample when buying and rejecting all that do not prove satisfactory. Then hold fast to that which does prove good.

A good liquid drier should be of a clear amber color when spread upon glass, and should dry hard and free from tack in eight hours, and after being on the glass seventy-two hours it should not resist rubbing with the finger, but remain firm.

Testing Japan Driers.—Attach a sheet of white paper to a pane of glass, and lay glass on table. Pour three or four drops of raw linseed oil on the glass, and on this place a drop of the japan. Incline the glass a little as the japan touches the oil, and watch carefully the action of the drier. A good drier will unite at once with the oil. If the drier refuses to mix at once with the oil, it is a poor article. Now, stir the two together with a pin or similar small article, and note if it curdles or not. A good drier will not curdle the oil it is mixed with.

Another Test for Driers.—Apply the driers to glass and let it dry thirty-six hours; then take finger nail or knife and scratch it. If it flies off in scales, it is poor. If it rolls up, gummy, under the scratching, it is slow but sure, not powerful, also not harmful to paint. If the drier cracks while on the glass, it is brittle. The odor of a drier is not a sure test. A liquid drier which, added to the oil in proportions of from 6 to 10 per cent., produces a good drying oil, that is, a hard and glossy surface when applied to a smooth plane, such as glass, in from six to eight hours, at ordinary temperature, is a good article. Color is not really important as far as quality is concerned. A light colored drier is every whit as effective as a dark drier, but the popular preference is for the latter.

Lightning Driers.—This drier is made both with and without gums, and, being a benzine liquid drier, it can be made cheaply. A sample made without gums dried on glass in two hours, while one made with gums dried on glass in thirty minutes. Such a drier is not fit for exterior painting, as it makes the paint more or less porous. The cheapest commercial driers will dry raw oil at an average cost of, say, 20c per gallon of oil; a good drier, costing twice as much, will dry the oil at the rate of, say, 8c per gallon. The best driers will do better work, too, in the wearing of the paint, than the inferior article will. This has been demonstrated by a practical painter.

Manganese Driers.— Manganese is an excellent drier, but is apt to turn white paint a pinkish cast; a combination of lead and manganese is best. A high-gloss drier at a low price contains much rosin, and no kauri gum. A good drier contains kauri gum, chips it is true, but which are just as good for the purpose as whole gum.

THE ACTION OF DRIERS ON PAINT.—When a film of raw linseed oil is exposed to the air at the ordinary temperature, a series of very complex chemical changes follow. I shall not trouble you with details of these changes, but shall simply say that under normal conditions there is a progressive absorption of oxygen from the air, the effect of which is that the oil becomes first viscous, then sticky, and is ultimately converted into a solid, elastic body, which consists largely of a substance called by chemists "linoxin." The oil is then said to be dry. The process of oxidation does not stop with the production of linoxin, but proceeds, slowly or quickly, according to the local conditions, with formation of secondary products, until the film, after reaching a maximum of elasticity and hardness, begins to crack, powder and perish, and is ultimately destroyed.

It has been known for a long time that if small quantities of certain chemically-active metallic compounds are dissolved in oil, the drying process begins sooner and the rate at which oxygen is absorbed is greatly increased. Those active chemical compounds which possess this property are termed "driers," and their function appears to be that of assimilating oxygen from the air and passing it on to the oil without their own chemical composition being materially affected. They have been termed "oxygen carriers."

Typical modern "driers" or "siccatives," are red lead, litharge, sugar of lead, linoleate of lead, resinate of lead, tungate of lead, borate of manganese, resinate of manganese, acetate of manganese, oxalate of manganese, tungate of manganese, and resinate of cobalt, while mention must also be made of Chinese wood oil and spirits of turpentine.

The effect known as chalking or powdering is particularly liable to occur in the case of paints which contain a preponderance of pigments which are in themselves driers. Familiar examples are white lead and red lead. The oxidation of the oil in such paints frequently proceeds so rapidly and so far that the paint film is burnt up and destroyed. This is particularly noticeable when too little oil has been used in the composition of the paint, and the effect is aggravated when a superabundance of turpentine has been used, there being no doubt that in such case the turpentine acts, in conjunction with the drying pigment, as a very powerful drier. A variety of powdering which is preceded with loss of gloss is found also in the case of paints whose chief constituent is oxide of iron. The cause of this is different from that which induces chalking in the case of lead paints, and is usually traceable to physical peculiarities possessed by oxide of iron pigments.

Cracking or checking is a defect which is frequently due to lack of elasticity in the paint film, and this lack of elasticity is not infrequently aggravated by the use of an excess of drying material, or by the use of drying material of an unsuitable kind. Some paints which contain considerable proportions of oxide of zinc are liable to this defect, which can only be overcome by the use of prepared thinning and drying materials specially suited to the nature of the pigment.

It appears to be the nature of a paradox to say that paint which contains too much drying material frequently fails to dry. Such, nevertheless, is the case. If oxygen is absorbed too rapidly by a paint film, secondary chemical action takes place which prevents the normal formation of linoxin, and these actions result in the formation of a sticky, non-drying product. A precisely analogous phenomenon is observed when linseed oil is exposed to the air in bulk, the familiar substance known as oil gold-size being produced in this manner.

When paint does not show any tendency to become hard, even when a considerable proportion of drying material is present, but remains wet for an indefinite period, unsuitability of the drier is indicated. Certain driers are slow starters of oxidation, but are efficient accelerators of oxidation when the process has been started. Linseed oil that is too new, or that contains suspended footy or albuminous matter, is very liable to retard, or even to inhibit, the normal action of driers.

Temperature exerts a powerful influence on the rate of drying, as also does humidity in the atmosphere. At very low temperatures drying is greatly retarded, and may even be stopped altogether; and it is often found that paint which has been exposed to a slow temperature, and in which the drying has been checked, does not dry normally afterwards, even when the temperature and other local conditions have become suitable. Moist or vitiated air retards the drying of paint, for the very evident reason that there is not a sufficiency of oxygen in direct contact with the paint film to enable the oxidation to proceed in a normal manner.

The influence exerted by different pigments on the rate of absorption of oxygen by linseed oil is very marked, and is an exceedingly complex, and in some ways abstruse, subject. The precise reason why such pigments as lampblack and yellow ocher, which have practically no chemical effect on linseed oil, should retard the drying of that medium is by no means clear, and some of the explanations offered to account for the phenomenon appear to be satisfactory only to the ingenious gentlemen who propound them. When pigments of this kind are in question, it is necessary to use a drying material which contains driers capable of starting oxidation quickly, and also capable of promoting the absorption of oxygen for a considerable period.

Some Drier Formulas

Patent Driers.—An old name for an old drier. Mix together 2 parts each of zinc sulphate and sugar of lead (lead acetate) and mix with 2 parts of best white lead or zinc white. Used with white paint, because it will not discolor it as dark driers will.

Litharge Driers.—Grind some best powdered litharge with drying oil to a paste, add to it a small portion of the paint it is to dry, and thin out with raw oil and turpentine, according to purpose of the paint; it is intended specially for a dark paint. It is a powerful drier and should be added to paint sparingly, not to exceed 4 parts driers to 1000 parts of oil.

Paste Driers.—This is similar to the patent drier formula, and is from a paint chemist, Scott.

Paris white	120 parts
White lead	50 parts
Zinc sulphate	15 parts
Sugar of lead	10 parts
Litharge	12 parts

Grind in 6½ gals. pale boiled oil. Adapted for all lead and zinc paints, and may also be used with such paints as green, black, oxides, etc. Substitute barytes or terra alba for the white lead.

Japan Driers.—To a gallon of raw linseed oil add 12 oz. gum shellac, 8 oz. each of litharge, burnt umber, and red lead, and 6 oz. sugar of lead. Boil until ingredients are dissolved, which will be about four hours. Remove then from the fire, and stir in one gallon of turpentine.

Cheap Japan Driers.—Mix together 4 lbs. each of red lead and litharge, and 2 lbs. of raw umber, with 4 gals. of raw oil. Boil slowly two hours, and add gradually 7½ lbs. gum shellac and boil thirty minutes longer. When well mixed add gradually 1 lb. of powdered zinc sulphate, and when nearly cold mix in thoroughly 7 gals. of turpentine.

LIQUIDS USED IN THINNING PAINTS, ETC.

Turpentine Spirits.—When distilled from the pure gum these spirits thin paint perfectly, aid drying, do not make "short" paint, prevent wrinkling, reduce the tendency of paint to become fatty, are not affected by cold, standing a temperature of 30 deg. Fahr. without danger, and work well over wet wood, because turpentine will mix with water.

It mixes with all paint oils and thinners, and is especially valuable because of its flatting quality. It does contain an acid that injures some pigments, such as flake white and rose madder, but such pigments have very little interest for the house painter.

Wood Turpentine Spirits.— Made from stumps and refuse pine lumber. The dry-distilled product has a strong, pungent odor and acquires a deep, yellow color with age or when kept in the dark. The steam-distilled spirits has less odor, is water-white, and does not turn yellow so soon. It is a quite satisfactory thinner, and is much used in place of the gum spirits. The specific gravity and flash point of the two turpentines are similar.

Wood turpentine has such a strong and pungent odor that many persons will not have it used by painters who do their work. But this odor may be almost entirely removed by redistillation, and the spirits retain their water-white color for a long time. Redistilled wood turpentine is now classed as pure commercial turpentine; if free from odor it is very satisfactory. The diluting power of wood turpentine is the same as that of gum spirits.

Turpentine Substitutes.—Heavy petroleum distillate, variously known as white spirit, heavy naphtha, and heavy petroleum distillate, or simply distillate, is the base commonly employed for making turpentine substitute. This liquid is water-white, something between benzine and kerosene, but does not leave as much grease on white paper as kerosene does. It is less volatile than benzine, flows better with paint than benzine, but it slightly retards drying. It is often used alone in place of turpentine, but more commonly it is "improved" by the addition of other liquids, such as wood turpentine to the amount of 5 per cent. to 20 per cent. and rosin spirit, or a mixture of the two and a little pine oil; in this way we get a better imitation of the true turpentine odor, and it will mix better with paint and varnish. Benzol also is sometimes added. A substitute containing no turpentine may be made from benzine 80 parts, kerosene 18 parts, and rosin spirit 2 parts. This makes a water-white fluid with a turpentine odor, due to the presence of the rosin spirit; it works well in paint, but not so well in varnish.

Another substitute is composed of equal parts of rosin spirit and heavy benzoline, and turpentine twice as much. Or, turpentine 1 part, benzol 1 part, and petroleum spirit 2 parts. Or, 1 gal. turpentine, 1 gal. rosin spirit, 2 gals. petroleum spirit, 2 lbs. rosin, and 2 lbs. gum sandarach. And so on, almost without limit. Most turpentine substitutes are made from foreign petroleum oil, which does not give a good burning oil, American petroleum being the best in the world for illuminating purposes, but which, particularly the Pennsylvania oil, won't make a good substitute, being too light. The Russian "turpentines" are too greasy and do not evaporate out well, some not at all perfectly. Some of these substitutes smell very like real turpentine, but have a woody rather than a gum odor, due to the presence of wood turpentine.

Benzine.—Benzine is a good thinner and a great solvent of oils, but it lacks some of the best properties of turpentine. It is more volatile; as a thinner of oil paint it abstracts too much oil, leaving the pigment with insufficient binder. It is a better thinner, as mere thinning goes, than turpentine, but it makes paint "short," it does not level or flat well under the brush, a fault particularly noticeable in varnish thinned with it. The tendency of benzine when mixed with paint is to make the paint more soft than common after the paint has dried. Grainers say that when the graining ground has been made of paint thinned with benzine there is a tendency of the paint to rub up. Benzine seems to leave some paraffine, causing the paint trouble spoken of.

It is well known that benzine will not flat paint as turpentine does; thin it with benzine until like milk for consistency, and when dry the paint will have more or less gloss. Again, white paint thinned with benzine will yellow, but with turpentine it will not. It is simply useful for thinning out the paint when that is all you desire of it. It will not injure the paint, as it completely evaporates. Why it should yellow paint is hard to understand, unless it is because of the paraffine it is assumed to leave with the paint, and which must be a very inconsiderable amount. It was discovered by oil-cloth makers that benzine yellowed white paint.

When you want to make enamel paint flow easier, some benzine may be added and the end will be achieved, and the finish will have all its gloss. Thin out with turpentine and the gloss would be wholly or partially gone.

Benzine does not work well on wood containing an excess of moisture, owing to the fact that it will not mix with water; turpentine does. Neither will it withstand a high degree of temperature owing to its rapid evaporation; in consequence it is useless in baking or japanning. Also, if chilled to near the freezing point it precipitates the gums in varnish, so that it is easy to see it is not adapted to either a hot or a cold climate.

To test benzine for purity place a few drops on white paper, and if pure it will completely evaporate in seven minutes, leaving no stain.

Benzol.—A product of bituminous coal, obtained by distillation. A by-product of gas works, from the resultant gas tar. Variously known as benzol, coal tar naphtha, and solvent naphtha. A water-white liquid, volatile, and leaves no residue after evaporation. A perfect solvent for rubber, oils, gum resins, etc. In connection it forms the paint and varnish removers of commerce. It may be used in connection with turpentine for cutting damar gum. Paint containing some rosin is inclined to granulate, and to prevent this some benzol is added. Benzol is useful for softening up an undercoat of paint, so that the succeeding coat will adhere; this may be accomplished by adding the benzol to the coating over the old paint. But benzol should not be used in paint at any other time, as it is too strong a solvent. It may be observed here, however, that some painters say they use it, in small amount, in place of the higher priced turpentine, but I do not so advise its use. In its brushing qualities it resembles turpentine more than any other spirit of its class. It is one of the best solvents known for rosin, and it is unaffected by cold temperature. Mixes easily with benzine, turpentine and linseed oil. Very inflammable, and must be used with care; insurance companies object to it. Very useful for painting over hard pine and cypress, penetrating those woods and softening up the hard gum.

There is a great deal of benzol being used in flat wall paints and in turpentine substitutes.

Benzols are made in several grades, having different evaporation points. Some kinds will evaporate in ten minutes, others require some hours. Painters will do well to use the one that evaporates in about 1¾ hours. This is technically known as solvent naphtha of 160 deg. This is almost as slow as turpentine. This is a safer benzol to use than the quicker ones. There is less danger of fire and explosion. Also, being slower, it gives the paint more time for penetrating the wood, and longer for softening up old paint. But for bronzing purposes it is better to use a quicker benzol, as bronze dries with a better luster the quicker the liquid dries.

Carbon Tetrachloride.—A perfect solvent for all substances that are soluble in turpentine, benzine and benzol; non-inflammable, it cannot be set afire. This liquid and chloroform are the only solvents that will not take fire; they may be evaporated in an open dish on a hot stove with perfect safety. It is colorless, like chloroform, and has a similar odor, but in much less degree. A perfect thinner for paint and varnish, rendering them less inflammable and hastening the drying process. But the cost of this liquid and its slight chloroform odor bar its use with painters.

Carbon tetrachloride is a good solvent for many resins, particularly such as are dissolved by benzine and mixed nitric and hydrochloric acids, but are nearly or quite insoluble in alcohol. A very good varnish may be made by dissolving gum damar in this solvent, heated to 120° F. Some resins of the copal class, which dissolve with difficulty in turpentine, and very slowly in boiled oil, dissolve readily in hot carbon tetrachloride. It also is capable of completely dissolving with alcohol many resins that with alcohol alone dissolve only partially, and with 10 to 20 per cent. added to the alcohol these resins dissolve completely. Gum shellac, sandarach, and some other resins, for example, dissolve but slightly in commercial denatured alcohol of 90° strength, owing to the presence of water; but they dissolve completely on the addition of the percentage of tetrachloride named.

Kerosene.—Popularly known as coal oil; it is a distillate of petroleum. It imparts elasticity to paint and varnish, especially the baking varnishes, etc. It promotes flow and increases the leveling property; it is very repellent of water. Not a drier, though with rosin and manganese it is possible to produce a fairly good combination drying oil. As a paint thinner it is not to be recommended, as it retards drying and causes separation of oil and pigment on metal, and to less extent on wood. A paint containing kerosene will peel and come off; it will also cause a coat of good paint, applied over it, to leave the surface. Kerosene should have no place in the paint-mixing shop. About 85% of this oil will evaporate, the residue remaining to injure the paint it may be mixed with. The relative evaporation of kerosene is 13, as compared with that of turpentine, 1,100. While some painters report good results from a moderate use of kerosene in paint, and while there is much of it used on the Pacific coast and in the South, still we must conclude that the evidence against its use is overwhelming.

Water.—Water is used both as a thinner and as an emulsifier, the latter to keep mixed paint in suspension. As water will not mix with oil, it is necessary to employ some medium to effect this union, and we find useful for this purpose alkali, glycerine and alcohol. Oil and alkali form soap, oil and glycerine form a glyceride, and oil and alcohol form a mechanical mixture. In adding an alkali to the oil for thinning paint, care must be taken not to add too much, in which case soap would result, while just the correct amount will form simply an emulsion. One formula may be cited as showing how the emulsion may be formed: Dissolve 4 oz. of borax (or 2 oz. of sal soda) in one gallon of hot water. Then add 1 lb. of gum shellac, either the bleached or orange colored, according to the paint desired, whether white or tinted. The alkaline mixture is kept at a temperature just under the boiling point, and the solution must be stirred until the gum is dissolved. This is usually accomplished in about thirty minutes. Strain the solution and add to any kind of mixed paint, the limit being one part of the solution to two of the mixed paint. The more common addition, however, is about one-tenth solution.

A mixed paint thinned to working consistency with turpentine, benzine, or linseed oil, will take one-tenth its volume of the solution, and apparently not be any thinner. The paint will then work very easily under the brush, and cover very well. The solution is designed to hold the paint in solution, preventing the settling of the pigments. But such a solution-treated paint is properly called adulterated. Any paint containing more than two per cent. of water is considered to be adulterated.

After the water of this solution has evaporated from the paint there remains the shellac combined with the oil forming a film that is very durable. Zinc white, lithopone, and other non-porous pigments have a tendency to form an enamel surface, and should be assisted by the addition of a more porous pigment, like silica, barytes or whiting, as this will prevent the film from becoming hard enough to scale when the water escapes. When water is vaporized by heat, it expands to several hundred times its original volume, and this expansion causes paint to peel off, particularly where the wood is not perfectly dry.

Rosin Spirit.—Obtained from rosin by distillation. A good solvent and thinner, but its yellow color and strong odor is against its general use in paint, though it is used in the varnish factory. Its principal use seems to be in the making of turpentine substitutes, as previously pointed out.

Gloss Oil.—This can hardly be classed as a paint thinner, though it is a very thin liquid, used to some extent by painters for size, etc. A factory formula for making rosin oil is as follows: "F" rosin 400 lbs., 59 or 62 deg., benzine 50 gals., producing about 90 gals. gloss oil. It has very little body, sets quickly, but with the addition of a heavy petroleum spirit this is retarded.

Pine Oil.—Pine oil is obtained from the distillation of pine and fir seeds, as a rule, but more or less wood and pitch are used in producing the commercial oil. It has a pale, yellow color, and smells strongly of rosin and spirit, or something like dry distilled turpentine. Not used as a paint oil, unless when added to mixed paint and varnish, to impart a turpentine odor.

Amyl Acetate.—Obtained from fusel oil and acetic acid by distillation. Used mainly as a solvent for celluloid and gun-cotton, in the preparation of bronzing liquids and spirit varnishes. Odor like banana liquid. Too expensive to be used as a thinner.

Amyl Alcohol is the principal constituent of fusel oil, etc.

Alcohol.—Ethyl or grain. Obtained by fermentation and the distillation of rye and other grains.

Grape alcohol from grapes. Absolute alcohol is that which is obtained entirely free from water, a condition not obtained by ordinary distillation, and effected only by the use of some dehydrating substance, as quicklime. Commercial absolute alcohol contains about 1 per cent. of water, and it is used only for special purposes. U. S. Pharmacopœia alcohol means a solution of 91 per cent. by weight of ethyl alcohol and 9 per cent. of water. Proof spirit or dilute alcohol means a solution of 45.5 per cent. of alcohol and 54.5 per cent. of water, both by weight.

Denatured Alcohol.—This is simply grain alcohol to which has been added a certain percentage of wood alcohol, usually about 10 per cent., which unfits it for beverage purposes and does not unfit it for all the purposes of an industrial character.

Wood Alcohol, or Methyl Alcohol.—Known also as wood spirits, wood naphtha, pyroxyllic spirit, and carbinol. Distilled from wood. Since the advent of denatured alcohol, and on account of its very poisonous and generally objectionable character, it is not much in use by painters now.

Acetone.—An inflammable liquid with a biting taste, and obtained by the destructive distillation of certain acetates, citric acid, starch, gum, or sugar. Used in making chloroform and as a solvent for fats, camphor and resins. Much used in the preparation of bronzing fluids and varnish and paint removers. The addition of one gallon of acetone to 25 gallons of wood alcohol will produce a solvent that will cut shellac more readily than wood alcohol alone.

Fusel Oil.—An acrid, oily liquid of a vile odor, accompanying the making of potato spirits, corn spirits, etc. It consists chiefly of amyl alcohol, hence is also known as amyl alcohol.

Water Glass.—Soluble glass. Silicate of soda. Silicate of potash. Consisting of silica which has been liquefied by extreme heat and pressure in connection with potash, giving potassium silicate, and with soda, giving sodium silicate. The latter is that commonly used by painters. It is of a syrupy consistence, and is dissolvable in water.

How to Distinguish Various Solvents.—The various solvents have certain characteristics which enable us to distinguish one from the other; amyl acetate and fusel oil are always recognized by their odor; carbon tetrachloride and chloroform by their odor and non-inflammability; benzol or solvent naphtha by its coal tar smell and property of mixing with both alcohol and turpentine; kerosene oil by its leaving a greasy stain on white paper; benzine by its odor, its flash point, and acid resistance; turpentine by its odor, its perfect mixture with varnish, and by the following simple test, which distinguishes crude wood spirit from the rectified spirits of turpentine:

In several small wine glasses or beakers place about half a fluid ounce of each of the following solvents, viz.: Turpentine, wood spirit, benzine and solvent naphtha. Now add an equal amount of strong hydrochloric (muriatic) acid, the acid must be chemically pure and colorless, then stir with a glass rod. After about two minutes the lower strata or layer of acid will be colored a pale amber or topaz-yellow in the case of pure turpentine; a bright red turning to brown in the case of wood spirit, or an orange brown if rectified; no change in the case of benzine, both strata remaining colorless; while in the case of solvent naphtha both strata remain colorless for about fifteen minutes, after which the lower strata takes on a very faint pink tinge.

Some Little-Used Paint Oils

Cottonseed Oil.—This is about the least adapted of any of the various linseed oil substitutes that can be used in paint. It is strictly a non-drying oil, and paint containing a very little of it will be slow in drying, while a greater amount will result in a very sticky paint.

Corn Oil.—As this is not used by the painter little need be said about it; besides which its cost is now too great to make it a rival of linseed oil. It was once very cheap, and then paint and putty makers tried to work some of it in, but of course, not with success. It is a poor drier.

Soya Bean Oil.—A semi-drying oil much talked about by paint makers. It may be used in connection with linseed oil, but used alone it will not produce as tough a film when dry as does linseed oil; it does not absorb oxygen from the air to anything like the extent that linseed oil does.

Poppy Seed Oil.—A drying oil, the cold-drawn oil being almost water white, while the hot-pressed oil has a pale, golden-yellow color. It is an expensive oil, and it is apt to be adulterated with walnut oil, in which case it is not suitable for fine white zinc and white enamel paints. It is valued in house painting because it will not turn yellow like linseed oil when kept in the dark.

Hempseed Oil.—A good drying oil and has a greenish-yellow color. It would very likely be extensively used as a paint oil if not so costly.

Rosin Oil.—This oil is obtained by distillation from rosin or pine gum. This distillation gives several products, the last two of which are rosin spirit and rosin oil. Rosin oil is cheap, and some of the cheaper linseed oil substitutes contain more or less of it. Barrel and cheap barn paints are often mixed with it. It dries hard in paint, but afterwards softens up, where exposed to the sun, and cracks very badly in the shade. It is the worst thinner that could be used.

MENHADEN OR FISH OIL.—From a small fish, larger than a herring. Three grades of this oil are produced, crude, brown, and bleached, or "winter white." The lower grade, the brown, is sometimes used in grinding dark paints, but the bleached is best, as the bleaching process eliminates much of the fish odor, besides making a clearer oil. Owing to its ability to withstand an intense heat, it is found very useful for paints intended for surfaces subject to great heat, such as smokestacks, furnace fronts, etc. Our paint experts consider fish oil as the best of the available oils in place of linseed oil, though much improvement will first have to be made in the oil to fit it for painting purposes in a general way. It dries well, or in about the same time as linseed oil, drying with a hard, waterproof film. Treated with litharge at a high heat it becomes very dark and yields an offensive odor.

CHINA WOOD OIL.—Known in China as tung oil, being obtained from the nuts of the tung tree of that country. It has been used by the Chinese for centuries, for waterproofing boats, for lacquering, etc. The color of the oil varies with the manner of its extraction. In China it is usually heated very strongly, which produces a heavy, dark product. It has the peculiar quality of drying more quickly in damp than in dry weather. An excellent feature is its hard drying properties. Used alone, it will dry flat, but the addition of as low as 10 per cent. of rosin by weight, hardened with calcium oxide, will produce a high gloss coating, drying to the hardness of a high grade copal varnish. It is useful for making the cheaper grades of varnish for painters and furniture makers, and for dipping. Exposure to the weather results in dulling the varnish.

When not darkened overmuch by heat the wood oil is clear and somewhat yellow of color, and has a peculiar odor, something between castor oil and lard oil. With scarcely any taste, it is the most rapid of the drying oils, drying in about twenty-four hours. Linseed oil dries from the surface, but wood oil dries uniformly throughout.

Wood oil has a greater body or viscosity than linseed oil, being considerably thicker, consequently does not possess the penetrative power of linseed and will not adhere so well. Owing to its waterproof character and its peculiar affinity for rosin it enables the varnish maker to produce a cheap varnish of durable quality. A varnish containing 50 per cent. of rosin made without the addition of wood oil, will turn white if immersed in water for a short time, whereas, with an addition of wood oil there will be but little change, the total amount of oil in the varnish being the same in both cases. China wood oil is superior to linseed oil in one respect only, and that is the toughening characteristics it gives to linseed oil varnishes containing rosin. It cannot be and is not used in place of linseed oil, but merely in addition to the latter in certain percentages. Even then it cannot be used in its raw state, but must undergo certain treatments first. Recently there has appeared on the market a paint oil composed of linseed oil and a treated wood oil, which has given fairly good satisfaction.

LINSEED OIL

LINSEED oil is obtained from the seed of the flax plant. In the early stages of the industry the seed was crushed and ground to a pulp, then pressed and the oil extracted at ordinary temperature. This gave an oil that contained very little foots, was quite light in color, and was of excellent quality for immediate use. The percentage of oil extracted, however, was not very high, so that at the present time no cold-pressed oil is made, but the seed, after being ground, is cooked, or "tempered," with steam, which breaks up the plant cells and allows of more complete extraction of the oil. This hot-pressed oil as it comes from the press is not fit for most commercial uses, as it contains considerable water and gummy substances. It is, therefore, filtered and stored in tanks and finally submitted to various processes, which remove the harmful ingredients and at the same time improve and bring out the special qualities most desired in the various kinds of paint and varnish oils on the market. The quality of the oils, therefore, depends not only on the purity and good condition of the flaxseed, but also on the care and thoroughness with which it is treated in the succeeding operations.

The chief value of linseed oil as a paint is in its power of drying in a comparatively short time to a hard, tough, elastic and durable film when exposed to air. The raw oil is a thin mobile fluid that flows well under the brush and has good spreading qualities.

It also has sufficient body to hold up the pigment and gives a paint that is uniform in color and appearance and does not run or get streaky. The paint film after it has dried should not crack, check or blister, if properly applied on a good surface. It gives off no bad odors, nor does it soften or deteriorate in the sun or when exposed to the weather. No other commercial oil possesses all of these properties to such a high degree. Claims are made for some of these oils and linseed oil substitutes now on the market that, as regards general painting purposes, they are equal if not superior to linseed oil, but these claims have not been fully proven, and until they have been it does not seem wise to run any risk when the best results are required, and where conditions are at all severe. In many cases the claims for these linseed oil substitutes are not true and their use results in great trouble and expense on the part of the painter, as well as considerable loss of reputation to him.

Raw linseed oil, as it comes from the press, is not yet suitable for use, and, as stated above, has to be filtered and stored before used. It is also further treated in different ways, depending on the use to which it is to be put. Several grades or varieties of linseed oils are, therefore, in the market, designed for different kinds of paint manufactured for the master painter, varnish maker, leather industry, for linoleum, etc., etc. The chief grades are the following:

Raw Oil.—This is the original oil pressed from the flax seed and from which all the other special oils are prepared. Before being sold to the trade, however, it must first be very carefully filtered and stored for a certain length of time. The "foots," as they are called, which are often found in an old barrel of linseed oil, are the gummy or mucilaginous matters which separate out of the oil on storage. The greater part of these are removed in the filter presses and storage tanks before the oil is shipped to consumers, but it is impossible to remove all of it from the raw oil, as it continues to settle out for a great length of time. The quantity of foots in a fresh raw oil depends partly on the condition of the seed, on the care used in cooking and pressing it, and in filtering. It depends also on the kind of seed which is used. For example, the Calcutta seed gives oil which has less foots than does that from the United States and Canada. This is partly the reason why in the old days Calcutta oil was valued so highly by the paint and varnish trade. At the present time, however, this does not hold so true, as with improvement in the methods of extraction and preparation of the oil from domestic seed, it is equally as good as any other, and is now given a preference in this and other countries.

A raw oil improves with age by reason of the more complete separation of the foots. It is the foots that tend to make the paint "tacky," soft, as well as slower drying, and the paint also is not so durable.

The chief use of this oil is in the grinding of pigments and in the mixing of paints by both the paint manufacturer and by the practical painter himself.

Boiled Oil.—There are several boiled oils on the market, each with its own particular use. They are all made, however, by boiling the oil with prepared driers under careful control and supervision. Each manufacturer has his own method of boiling, the details of which are rather jealously guarded. The addition of the drier to the raw oil causes the resulting boiled oil to dry in from 7 to 12 hours instead of from 48 to 72 hours, not on account of the oxidizing action of the drier on the oil, but by its action as a carrier of oxygen from the air to the oil. It acts as a sort of go-between in first taking up oxygen from the air and then giving it up to the oil, thus causing the latter to dry and harden more quickly than it otherwise would do.

The boiling of the oil also sets free the "mucilage" in the oil, practically all of which is removed in the process. A boiled oil containing a large excess of foots should always be looked upon with suspicion as showing evidence of having been "bung-hole-boiled," *i. e.*, of the drier having been added to the raw oil after it has been placed in the barrel without being boiled at all. A certain amount of foots, however, is usually present, which, in a great many cases, has settled out after the oil was put into the barrels, and cannot be overcome, as this quality of oil cannot be filtered commercially by the manufacturer.

Among the different boiled oils on the market we would mention the following:

Kettle-Boiled Oil.—In the old days all boiled linseed oil was prepared in an open kettle heated by direct heat from a fire built beneath it. This has to be very carefully done, not only on account of the danger from fire, but also on account of the possibility of overheating and damaging the quality of the oil. If properly prepared, however, it is of the highest quality and usually commands a somewhat higher price than ordinary boiled oil. It is usually slightly darker in color, chiefly on account of the higher temperature to which it has been raised.

Ordinary Boiled Oil.—This is much the same as kettle-boiled oil, except that it is heated in steam-jacketed tanks or kettles and larger quantities of oil are taken at a batch. The oil is also probably not raised to such a high temperature, although, if carefully prepared, it should be of good quality for most purposes. On account of the lower temperature used in its preparation it is lighter in color than the kettle boiled. A very large percentage of the boiled oil of commerce is made by this process.

In addition to these principal kinds of linseed oils there are certain other special oils, each of which has its uses. Among these we would mention:

Heavy Raw Oil.—This is a raw oil treated in such a way as to make it less fluid and with more body to it so that it can hold up a heavy pigment in suspension better than ordinary raw oil. The pigment does not settle so quickly and the paint does not have to be stirred up so much while it is being used. The coat of paint is, therefore, more uniform in appearance and more pleasing results are obtained. It should dry in a slightly shorter time than ordinary raw oil, but not as quickly as boiled oil. Its principal use so far is in the grinding of pigments by the paint manufacturer, although we do not see why it should not be equally valuable to the painter himself.

Heavy Boiled Oil.—This has much the same qualities as the heavy raw oil, except that it dries more quickly, and is used by the paint manufacturer and painter where he requires a boiled oil for heavy pigments and where quick drying is essential.

Extra-Pale Boiled Oil.—This is a light-colored boiled oil with specially quick drying properties and is used in the grinding and manufacture of light-colored paints and in enamels.

Varnish Oil.—As its name signifies, it is used for the manufacture of varnishes of various kinds. It is not a boiled oil, but is treated in such a way that it will not "break" by any application of heat. When ordinary oil is heated up to moderately high temperature a flocculent gummy precipitate, called the "break," separates out. An oil varnish consists of resin dissolved in linseed oil at high temperature, the solution being afterwards thinned with a volatile solvent. Owing to the high temperature used in varnish preparation, the varnish oil must have its breaking property entirely eliminated; but, on account of the expensive and elaborate applications of oil varnishes the oil must retain its durability and elasticity unimpaired by the treatment given to prevent breaking. Each linseed oil manufacturer has his own particular method by which he removes this breaking property, the quality of the product depending partly on the process employed, but largely on the careful attention given to the oil while it is undergoing the treatment.

Refined Oil.—This is an oil which has been bleached out and made of a yellowish white color. It is especially useful in the grinding of white paints, as it does not injure the color of the pigment. It usually does not "break" on heating, because the breaking element in most cases has been removed. Strictly speaking, however, it is not a varnish oil, although some brands may be used for this purpose if combined with a suitable drier. Bleached oil, like raw, dries slowly, and it is customary to mix suitable driers with it. The process of bleaching has to be carefully controlled since if it is carried too far it injures the good qualities of the oil. For this reason a very white oil is not to be recommended.

Aged Oil.—This is a thick, heavy oil which has been partially oxidized and the "break" removed. It dries, therefore, somewhat quicker than ordinary raw oil. Its special use, however, is in the manufacture of patent leather and linoleums, in which industries large quantities of it are used.

Adulteration of Linseed Oil and Linseed Oil Substitutes

Within the past few years this has been practiced more than formerly. With the increasing demand for linseed oils and its increased price, many attempts have been made to find an oil which would take its place and at a lower cost. So far this has not been completely successful, although for some purposes, as in the case of cheap paints, for steel work and other similar work, some of these oils have found considerable use. For woodwork, however, both interiors and exteriors, and where the highest class of painting is required, a substitute oil has yet to be found which will completely take the place of linseed. Some of them are used in admixture with linseed oil and are sold under various trade names, apparently chosen to mislead the public as to their real character.

In all fairness to the manufacturers of linseed oil, we must say that we do not believe any of them knowingly adulterate their products. Of course, cases of bad oils have come to our attention in which the fault was due to improper preparation of the oil before being shipped. In most cases, however, the trouble is found to be due to adulteration of the oil after it has left the manufacturer, by unscrupulous jobbers, retailers, etc. This is the case particularly when the price of oil has advanced to a point where it makes it profitable to add 5, 10 or even 20 gallons, of some other cheaper oil to the original barrel of linseed. In other cases where only a small quantity of oil is sold it has been found that the measuring can or container has not been clean, and as a result all manner of trouble arose when the oil came to be used.

The oils which are most commonly used for this purpose we have found to be:

Rosin oil, mineral oils, such as benzine, kerosene, and even some grades of lubricating oils; fish oils, China wood oil, Soya bean oil, corn oil, hemp or rape oil.

When these are added by the jobber or retailer they are almost certain to seriously affect the quality of the oil and cause damage to the paint with consequent loss of time, money and reputation to the painter. The cheapest and most frequently used adulterants are the petroleum oils. These are lighter in weight than linseed and consequently reduce the specific gravity. Rosin oil is, therefore, frequently added with them to increase the specific gravity. Fish or menhaden oil is sometimes used, the latter forming a constituent of various smokestack paints, but should never be used for interior work on account of the smell given off by the dried paint. It also causes darkening of the color in time. The worst linseed oil substitutes are those consisting of solutions of rosin in hydrocarbon oils, which are again mixed with tar oil and rosin oil. Such imitations dry without durability. Other substitutes are obtained by dissolving metallic resinates in tar oil or petroleum. Many substitutes are made with rosin oil, but they are apt to dry very slowly and remain sticky, and when used for painting will damage even a subsequent good coat, so that nothing but actual scraping off will remedy a coat of paint which proves defective as a result of using rosin oil.

An oil sometimes used for adulteration is corn oil, which, however, possesses practically no drying properties and can only be used in small quantities with linseed.

China wood oil, or tung oil, is rapidly becoming conspicuous as a linseed oil substitute. As received from the Chinese, it is often heavily adulterated and considerable variation in shipment of this oil is found. The crude oil dries with extreme rapidity, but with an opaque film of wax-like character with no elasticity. It cannot be used in its raw state, and requires to be chemically treated. This has to be very carefully done or else the result is a failure. Many firms have tried to introduce this oil as a substitute for linseed oil, but without any great measure of success. When heated to about 350° F. it suddenly thickens to an insoluble gelatine-like substance which cannot be softened again. It is nearly always used in admixture with linseed oil. Its characteristic lard-like odor can usually be detected, even when only small quantities are present. This is found to be an objection to it for use as a varnish. It does not dissolve in alcohol and hence cannot be used for spirit varnishes or lacquers. In cheap oil varnishes it dries with a flat, frosty, crawling surface. Varnish makers claim that by the use of China wood oil a satisfactory varnish may be prepared, but the process is one of much delicacy, and few manufacturers have been successful with it. The rosin content of the treated wood oil is also apt to cause checking when it is used to any extent in paints for the protection of wooden surfaces.

Soya bean oil is used by some paint manufacturers who claim that certain pigments are less liable to harden in the package when ground in an oil mixture containing Soya bean oil than with straight linseed oil. It, however, is not really a drying oil, but a semi-drying oil; on this account it is not nearly so good as linseed oil for paint purposes. Tests which have been made with this oil show it to dry much more slowly than linseed oil, and the color of the paint becomes darker upon exposure than is the case with a paint made from straight linseed oil.

Some of these adulterations can be detected by the painter by the ordinary application of the senses of smell and sight, also by observing the results obtained. In most cases, however, only a chemist can accurately do this, and then only with considerable difficulty.

It can thus be seen that linseed oil as a paint oil cannot be replaced by any of the other drying oils now commercially available for work of the highest character, and this is the only kind of work which any painter wishes to do if he has any regard for his own reputation and for the interests of his customers. We have endeavored to explain the properties of linseed oil, which make it so valuable to painters, and to the paint manufacturer, and also the reasons why linseed oil is superior to any other oil for these purposes. The statements which we have made and the facts given above have been proven many times by men of the highest standing and reputation, as well as by the actual experience of nearly every practical painter. The time may come when a process will be worked out which will produce other oils of equal quality, but this has not yet been done, nor have the claims made by manufacturers of other paint oils that they are the equal of linseed oil in every respect been proven by practical experience and trial.

Testing Linseed Oil.—Chemical analysis is the only accurate way to test an oil. As this is not practicable with painters and only can be done at considerable cost, in the laboratory, we must use some of the simpler means. There is the "spot test," a very reliable method. On a sheet of glass place a spoonful of oil, and allow it to flow out; then with a dropper let fall in the middle of the oil a drop of concentrated sulphuric acid; if the oil is pure the acid will not spread, but will burn the oil in a spot of about 1/4 inch diameter. If the oil is impure either a bloom will appear on the surface surrounding the spot, or minute veins will radiate from the spot towards the body of the oil.

The cold or freezing test is another good one. Pure linseed oil becomes about the consistency of lard at a temperature of about 16° to 25° F. An oil that becomes as thick as lard at a higher temperature than this is not pure linseed oil. Cottonseed oil congeals at about 5° above zero, F., making 20° to 25° difference between it and linseed oil; fish oil at about 32° F., while the oil from warm-blooded animals will congeal at a point above this. Rosin oil congeals at zero, rapeseed oil at about 25° F. above. Hence, when any of these oils are mixed with linseed oil the resultant oil will assume a semi-solid appearance at some point above 16° F., below zero, according to the kind and amount of adulteration of oil used.

A good quality of linseed oil, raw, will gain from 16 to 17½ per cent. in weight in drying, and boiled oil, say, from 15 to 17 per cent. An oil containing benzine or turpentine will show a decided loss during the first hours of drying and some of the cheap oils used in paint will show an ultimate loss in weight, instead of gain. With a chemist's balance at hand the quality of the oil may be ascertained by mixing it with an excess of an inert substance, say, silica or barytes, and then weighing the mass from time to time, as it dries.

Substitutes for boiled linseed oil are, as a rule, mixtures of rosin, linseed oil, more or less, crushers' driers, and some thin oil, mineral most likely. Many of these substitutes contain rosin or rosin oil, benzine and kerosene oil. If the painter will use an adulterated oil it would be money in his pocket to make it himself. The use of adulterated oil cannot be defended upon any rational grounds, and the man who uses it injures his patrons and himself.

A very simple and effective way for testing linseed oil suspected of containing petroleum oil is to fill a bottle about one-third full of the oil, then almost fill with a strong solution of sal soda or potash. Shake well, when the mineral oil will separate from the linseed oil, the latter forming with the lye a soap. The mineral oil will not saponify, but remains unchanged.

To test an oil for rosin, take equal volumes of the oil and grain alcohol and mix them well by shaking in a test tube or long bottle. Let stand for one hour, then pour the alcoholic layer into another clean test tube or bottle. Into this alcoholic solution let fall two to five drops of solution of sugar of lead (lead acetate). Set aside for six hours. If the oil contained any rosin a permanent white sediment will be found precipitated on the bottom of the bottle. This test will also indicate if a boiled linseed oil is a true kettle-boiled oil, or a so-called "bung-hole" boiled oil —raw oil to which has been added a rosin drier.

The presence of mineral oil was formerly easily detected by its bluish color or bloom, but the adulterators have now succeeded in eliminating this, and hence other means must be employed in detecting its presence. Placing some suspected oil on the palm of the hands and smelling odor of the same, after briskly rubbing the palms together, causing heat, will disclose the easily recognized smell of fish, rosin or mineral oil. Linseed oil has a sweet and agreeable odor, when fresh, but old oil may be quite different from this.

Oil adulterated with petroleum oil will have a cloudy appearance, and the film after drying will be easily removed by scraping with the finger nail. Pour out some oil on a piece of window glass, made perfectly clean, and note the time required for drying. Raw oil takes several days, but it will finally become dry; boiled oil will dry in from 7 to 12 hours, but much depends upon the temperature or atmospheric conditions.

Oils may be divided according to their drying properties as follows, giving the principal oils of each class:

Drying—Linseed, walnut, tung, poppy, sunflower.

Semi-drying—Rape, Menhaden, cotton, hemp, sesame, Soya bean, maize (corn).

Non-drying—Olive, palm, castor, almond, cod liver.

Linseed oil has more useful qualities than any other single paint oil. A few other oils have merit, but cannot be used in the raw state in the same manner that linseed oil is used. Raw linseed oil is extremely elastic, expanding and contracting with any kind of surface on which it may be used. It is also very penetrating, excepting in cold weather, when the addition of a little turpentine aids it. When raw linseed oil is spread on a flat surface, either with or without the addition of pigment, it gradually crystallizes into a hard film, there being absolutely no evaporation whatever. The best linseed oil, therefore, is the one that will absorb the greatest amount of oxygen in the least time, in other words, that will dry in the quickest time. A fair or average good linseed oil when spread out in a thin layer as suggested, on a smooth surface and under favorable conditions, should dry and harden in from five to seven days.

Double-boiled oil is that which has reached about

300° C. When boiled four hours at the maximum heat the oil will lose exactly 5 per cent. of its bulk. This adds also to the cost of the boiled oil. Boiled oil is not as elastic as raw oil, but it dries quicker, and makes a gloss finish that raw oil cannot. Boiled oil is in fact a varnish, though it does not dry as hard as a gum varnish, of course. Painters, as a rule, when using boiled oil, use too much, which causes wrinkled surface. As to which is the better, raw or boiled, there has been some discussion among practical painters. Boiled oil certainly has some objectionable features, and raw oil few or none, practically speaking. Boiled oil has a tendency to blister, and it will wrinkle the paint if the painter is not careful in its use. The trouble is, that the oil dries on top, leaving the inside soft, which when the sun strikes it will turn to blistering. The addition of some turpentine to boiled oil will help it, hardening it some, and red lead with it seems to make a good coating. Also graphite paint seems to do better with it. Double-boiled oil is particularly unsafe on exterior work. A correspondent of the *Carter Times* believes that in a cold climate boiled oil is better than raw oil, but that in a warm climate raw oil is best. He says he has used boiled oil on seacoast painting with success. An old painter, who as a boy helped boil oil in the shop, says such an oil paint lasted from 15 to 16 years to his own knowledge. Another painter tells of a job of painting he did more recently, for which he received $10 extra for using an oil that he himself boiled for the job, and that job was in good condition ten years later; there was no scale, crack, or other sign of deterioration. These facts are of great value to us as painters.

PAINT TROUBLES—THE CAUSES AND CURE

Mildew.—Mildew comes from minute spores or seeds of a plant. There are two kinds, one, a parasite, living on live tissue; the other lives on dead matter. In the latter we recognize paint mildew. This mildew occurs as well on linen, wall paper, leather, etc., in the presence of dampness. Smut, vegetable rust, etc., are other forms of this mildew. It thrives best where there is heat and moisture. On paint, developing from an invisible spore, in a few hours it becomes a quite visible black spot or speck, thus growing rapidly into a dark brown or reddish splotch. These black or dark brown spots or streaks are by far the most serious growths, destroying the life and the adhesive quality of the paint, causing it to lose color and to become powdery. If it is permitted to remain it will destroy the wood, which will then have the appearance of having been burned, and the black or brown spots, under a microscope, will have the appearance of soot. Surfaces painted with pure white lead or zinc oxide are less liable to mildew than those painted with ochers or similar earth paints. Being ground very fine, lead and zinc form a harder surface and one more impervious to moisture, hence more immune from mildew. Probably induced by dampness or shade, mildew on paint can be avoided by application of the paint only during dry weather. Warm or foggy weather favors the trouble. And it may occur between two coats of paint, or on the bare wood, under the first coat of paint. Paint applied to a cold surface and followed by warm weather may induce it. Linseed oil containing some foots or flocculent matter may cause mildew. If the trouble occurs on one building and not upon one adjoining and painted at the same time we may direct suspicion upon the wood. Too much driers in the paint will sometimes account for mildew. Fatty paint also will cause it, the soft paint never drying hard, and under certain weather conditions it will favor mildew. Mildew on paint is not of frequent occurrence, and on hard paint it may not occur at all. It is thought that zinc oxide paint never mildews, and as a rule those paints only that are made up of coarsely ground pigments mildew. Mildewing occurs where the building is exposed to ocean air.

To remove the mildew there are several methods. Sandpaper the mildewed part well, then apply turpentine, rubbing it well. After the turpentining sandpaper again, then apply a coat of dead flat paint. The subsequent coats of paint may be such as are usually applied. In close rooms, cellars, etc., mildew may be treated with powdered sulphur, dusting it on. Or sulphur fumes may be used. This method has long been in use by greenhouse people. Dark or close rooms that show mildew on paint or walls should have plenty of ventilation. Fresh lime with bluestone is efficient against mildew. As mildew occurs also on drop cloths and scaffold ropes, causing rot, the bluestone solution is advised. Mildew at the seaside may be prevented by using a compound paint having the following formula: Zinc oxide in oil 80 per cent., white lead in oil 20 per cent., mix with enough turpentine to form a flat paint. That is the first coat. The second coat may be made of 15 per cent. lead, 25 per cent. zinc, thinned out with raw linseed oil. This paint is considered by those whose business requires them to do sea-shore painting as the only one that will stand the wear and prevent mildew.

For brick and concrete walls subject to mildew try the following formula: Dissolve a pound of paraffin wax in a gallon of benzine and apply the liquid with a paint brush, rubbing well into the surface. A master painter says that he once washed down a mildewed house with soap powder dissolved in hot water; he followed this with rinsing down with clear water. When this was dry he applied a paint made from 85 per cent. white lead and 15 per cent. zinc white. He added that the work looked well for a long time after that. In fact, the turpentine and soap powder treatments are about the only sure remedies.

Peeling of Paint.—Sometimes called scaling, and is usually accompanied by cracking. The causes are many. Lumber not dry when painted, dampness back of the wood, ocher priming, defective old paint coat, resinous wood, the use of boiled oil in the priming coat, a hard pigment forming the paint, such as zinc or barytes, for primer coat, or too much of such pigment in succeeding coats, petroleum oil in the paint, bad paint mixing, and fatty linseed oil. Paint applied over a coat thinned with more or less mineral oil will certainly peel. The use of hard pigments, such as ocher, zinc, barytes, etc., will cause a very hard surface, and as it lacks in elasticity it is bound to come off. A primer made up of dark pigments will not hold well. This primer will cause cracking and peeling when the painted surface is much exposed to the weather, and blistering in shaded or protected parts.

The priming coat is the important one. Use the best raw linseed oil and white lead, make the paint thin, rub it in well and let it become perfectly dry before applying the second coat. And it is advised to make up the succeeding coats from the same materials, then there will be a natural bond of the coatings.

Paint Scaling from Iron or Steel.—The scaling of paint on iron, steel, zinc, etc., is due to any one of three causes: sweating, expansion, and contraction, taking it for granted that the surface has been properly primed and painted. Sweating is moisture, and this gets under the paint and off it goes. Contraction and expansion are identical in effects; the process causes the paint to crumble and fall off. Zinc and galvanized iron have a non-porous surface, and paint gets no foothold thereon. Such metals should be treated with an acid, as directed in another part of this work.

Blistering of Paint.—This trouble is like peeling in some respects. And the cause is the same in both cases. Dampness, poor paint, unfavorable conditions, cheap ocher priming, fat priming paint, priming coat not dry when second-coated, coal oil, benzine, low grade ready-mixed paint, sappy wood, etc.

It is worthy of note that where the best white lead, oil and japan driers are used, and such in former years were employed exclusively, there is no scaling, blistering, etc. The use of the best paint materials and their proper application are the sure preventives of all these troubles. By proper application means the preparation of the surface also. Dampness will cause blistering, hence you must see that the wood is dry before the paint is applied. But sometimes the wood seems dry and yet is not. Yet if dry enough to absorb a proper amount of the paint you will not likely have any blistering. If the wood is damp enough when painted the paint gets no hold and in time the sun will cause it to leave the wood. A paint blister is caused by heat and moisture; the heat vaporizes the moisture and softens up the paint; the vapor raises up the paint into blisters.

It is a common observation that dark paint is more liable to blister than white or very light-colored paint. This fact may be explained in this manner: The dark pigments take up more oil than the lighter colored pigments, and do not dry as hard nor as quickly as the other pigments named. Hence if the coat on top of this is applied too soon, or before the under one is really dry, the under coat will soften under the heat of the sun and cause trouble. Notice how dark bronze green on window blinds so often is blistered. Look at the door frame or window frame done in white, let us suppose, and it will show no blistering. The more lead or zinc mixed with the dark paint the more durable it will prove. Then it is to be remembered that the light colors reflect the heat, while dark colors absorb it.

Old painted surfaces should be treated first to make it sure of taking and holding paint. Wash with soap powder and water, or rub with turpentine, following with a paint containing some varnish. Very heavy or thick paint will sometimes cause blisters.

It is commonly believed that blistering is more likely to occur when boiled oil is used. Boiled oil should never be used in the priming coat. Often the painter uses too thick a paint and does not rub it out enough. Probably a third more paint is used on an outside job than necessary; thinner coats, well rubbed in-and-out will give better results and take less paint. Some painters favor applying the priming coat liberally, in order to get the wood filled with the oil; but the surplus should not be left on the surface, but be brushed off. With many woods a little turpentine in the priming coat will help it penetrate better. It is worthy of mention here, in this connection, that the board in the shop on which the men rub out their brushes, and which is usually coated to a great depth with paint, never scales, cracks or blisters. This is no doubt due to the fact that those rubbings result in the deposit of a very thin coating each time, and are of course not exposed to the weather.

Paint sometimes blisters over pine knots that have been treated with shellac and too heavy a coat put on. Shellac varnish offers a very hard surface, and paint will not attach to it very well. When the hot sun gets at such a spot blistering is bound to occur.

Paint Spotting.—If the lumber is of uneven texture, with sappy and hard places, the paint is sure to show it. The best plan is to prime such lumber, say, the weatherboarding, and allow the job to stand until all the spots have developed, after which go over the surface and touch up all the parts where the paint has sunk in. Laps, due to poor painting, will show in the finish and cause spots. The disfigurement will become more pronounced as time goes by, by the fading out of the thin places on the surface.

Streaked and Spotted Painting.—Streaked or spotted painting may be due to two or three causes. It often happens that the pigments made use of are what may fairly be termed "composite," by which is meant different chemical substances constituting pigments; and often in cases where the pigment is nearly all one chemical substance, as in chrome yellow or white lead, it frequently follows that materials made at different times differ in both shade and fineness, but are subsequently mixed together. In cases where a pigment is composite, our experiments seem to indicate that there is a tendency for the very finest particles to separate from those which are coarser, so that each successive brushful taken out of the bucket may contain a larger percentage of the fine, and a smaller percentage of the coarse particles than the previous brushful, at least while the first half of the bucketful is being used. In some paints it is actually noticeable that the last end of the job is of a different shade from the first, especially if the painter has not stirred his bucket of paint frequently. This separation of the different constituents of the paint is also especially true of those composite pigments which are made up of some heavy bases, with some organic or light coloring matter; for example, Tuscan red, which, as is well known, is a mixture of oxide of iron known as Indian red, with some of the red lakes. It may fairly be claimed that this difficulty of spotted or streaked work is more a question of care on the part of the painter than of the proper mixing or proportioning of the paint, and this is to a certain extent true, but it is not wholly so. Poorly ground paint is especially liable to give streaked results, and no amount of subsequent stirring or mixing on the part of the painter will make a pigment consisting of very coarse and very fine particles a good one to spread, or make it give a good-looking job. Both fine grinding and great care on the part of the painter are essential to obviate this difficulty. It, of course, goes without saying, that those pigments which, from their nature, have a tendency to produce this difficulty, should not be mixed where it can be avoided, although in our belief fine grinding will almost entirely overcome it with any pigments, whatever they may be.

Paint Streaking, Spotting, Etc.—If the paint streaks under the brush it may be sure that the paint was poorly mixed and not strained. But if the streaking occurs after the application and drying of the paint the cause is probably due to dampness, etc.

If the oil paint in time shows loss of gloss in spots the cause is due to the driers used. Sometimes a spotty condition of the finish coat may be due to having a different color under the last coat. Litharge and sugar of lead used as driers will often cause spotted paint.

Paint Creeping or Crawling.—Sometimes called cissing. The paint draws up in little patches, and will not hide the surface properly. Cold weather and a hard gloss surface are the principal causes. In either case rub the surface with a rag wet in vinegar or benzine. A painter tells us that he covers a bit of block with a piece of woolen cloth or soft leather and rubs the part with it. In any case the object is to remove the gloss.

Running of Paint.—This occurs most frequently in late fall and winter, when the surface is cold and possibly somewhat damp. If it is a raw oil paint, it is more likely to run than where boiled oil is used. Add more driers to the raw oil paint to cause it to dry sooner. A paint that is too heavy for the kind of paint that it is will run; to explain, if it is a thin paint and you try to apply it so as to have a heavy coating it is bound to run. When the contractor tries to skimp the job by using paint that is entirely too thin it runs. The finer a paint is ground, and the finer its constituent pigments, the less liability to run. Also, a paint after its application should dry in a normal period, otherwise it will be apt to run. The paint should set in from four to eight hours.

Wrinkling of Paint.— This sometimes occurs when frost catches the freshly painted surface, particularly if the paint was made thin and flowed on.

Wrinkling will occur in hot weather too, if too thin and full.

Pitting of Paint.—This is not an inherent fault of the paint, but is due to mechanical causes or accidents, such as the falling of rain or hail before the paint is dry.

Thinning of White Lead Paint.—By this is meant the thinning that sometimes occurs with a pot of white lead paint some time after it has been mixed. Pulp lead, or white lead that has been ground in water instead of oil, and the water not entirely eliminated, will cause this thinning by forming an emulsion with the lead and oil. Also excess of hydroxide in the lead will cause it.

Frosted Paint.—This mostly occurs on painted work that is fresh when night falls, the damp frosty air injuring the gloss of the oil. The frosted surface is rough and soft, like rubber. Prevention is better than cure. In winter no outside painting should be done after noon, at least not on those parts that are exposed to the prevailing winds. A cloudless night is sure to frost the paint. The worst effect of this frosting is appearance, and the parts may be treated by rubbing with an oily rag.

Trouble with Dark Shade of Blue Paint.—Some blues of a rich dark hue are composed of some black with the blue. The black is of less density than the blue, hence is apt to come to the surface in application, causing streaks of darker color than the paint itself. To avoid this add a little bluish-gray paint to the blue when the latter is to form a body color. The gray may be made from white lead and black, adding also a little of the blue. It must of course be sparingly used or it will change the color of the blue body paint.

Why Graining Cracks.—Expert grainers give various causes. Some say that it is due to unripened varnish, others that the color used in graining was fatty. Or the ground color contained too much oil. The surest body paint for graining grounds may be made from white lead of the best grade tinted with the purest and finest ground pigments, the mass thinned with proper proportions of turpentine and driers only, there being enough oil in the lead and colors to bind. The idea is to have such a ground dry flat. The graining color should be made fresh for each day's use; at least it should not be used after a day or two. Do not add any oil to thin up with, as it is being used. The graining should be given two months for drying before varnishing it. Some grainers rub exterior graining with oil, rather than use varnish. Never use a heavy-bodied varnish on graining. Rather, use a light-bodied varnish, containing much turpentine.

TACKY PAINT.— Cheap, ready-mixed paints sometimes dry tacky, and always when they contain more or less rosin oil. A soft under coat of paint may cause the finish to dry tacky. This is always the case where too much driers have been used in the under coat. Tacky varnish is a frequent trouble with church pews, and if the varnish has been applied over a poor paint it is sure to occur. Some colored paints are very liable to dry tacky, as when they contain much poor drying pigment, like lampblack, yellow ocher, barytes, clay, or silica. Drop black is another poor drier. Chrome yellow in such a compound would prove very bad. It is a good self-drier, but in connection with the pigments mentioned the result would be bad. Greens made as above are what we have in mind, as they seem particularly bad. Prussian blue and chrome yellow, both good self-driers, would make a green less unreliable. Seashore painters have much trouble with such greens, also with Indian red and Tuscan red. They try to avoid trouble by adding a little spar varnish to the last coat, one pint to the gallon of paint. This gives a paint having high gloss and a hard surface after drying, proof against moisture.

Salt Affecting Paint.—For surfaces exposed to the action of salt, as in warehouses where salt is stored or ships carrying salt, red lead paint has been found the best and most resistant.

Brush Marks on Painted Surface.—The difficulty of brush marks remaining prominent on paint is largely a question of the relative amounts of liquid and pigment. The nature of the pigment used also comes into the question, and the nature of the grinding, whether fine or coarse. But perhaps the most important item is that of the liquid used. If excess of a thick japan drier be used, or heavy boiled oil, other things being equal, brush marks will be more prominent than where raw oil and limpid japan have been used, though the proportions of liquid and pigment used will still be the important consideration.

Chalking of White Lead Paint.— Under the head of white lead this subject will be more fully treated than is feasible here. Some think that chalking indicates a poor white lead, but not so, for the very highest grades will chalk. Others believe that the trouble comes from adulteration, mentioning whiting as a probable adulterant, but then white lead of the purest will sometimes chalk. It is the opinion of many experts that where plenty of oil is incorporated with the white lead in making white paint the chalking will not occur.

Painting over Aniline Red.—There are two aniline reds, one known as a bleeding red, the other non-bleeding. To ascertain which, when you have a job of painting over aniline red, wet a rag with some turpentine and rub it over the red; if it is not a fast red some of it will show on the rag. Shellac is commonly advised for coating over bleeding red, but it is known that the dye is powerful enough to come through that hard substance, if the red is spirit stain, though some have success from applying two coats of shellac and a coat of washable water paint, and in very bad cases two or more coats of the water paint may be necessary. A chemist gives the following formula for preventing the stain from coming through: Take copperas one pound, hot water one gallon; place the copperas in the hot water, where it should dissolve. In another vessel mix together one pound of alum and one gallon of hot water. When both are dissolved mix together and apply freely. The chemical liquid acts as a mordant, preventing the red from staining through the paint.

Yellowing of Inside White Paint.—White paint, whether made up of lead or zinc, will darken unless given plenty of light. This is why inside white so often turns yellow, though it is not the sole reason; if too much linseed oil is used in the mixing, the paint will yellow. This is why the last coat, or on the best work the last two coats, are mixed with turpentine only, and in some finer jobs there is practically no oil at all in the paint; turpentine does not act as a darkener, though benzine does. Should the painter have a room to paint, and which once was white but now old ivory, let him first treat it to a thin coat of white shellac. This may not prevent the old yellow paint from affecting the new white paint, but in most cases it will.

Livering of Mixed Paint.—Ordinarily a pot of mixed paint may be left standing for a long time without livering or thickening, and at the worst all that would happen would be its getting more or less fatty or oxidized. Hence livering is not the ordinary matter, and is no doubt due to the action of some soap-making element in the lead or driers used in mixing the paint. Certain pigments are alkaline, sufficiently so as to cause the oil to saponify. Soap is the result, but not the soap in common use; it is a metallic soap, which are driers and they act upon the paint to cause it to dry with a hard film. Saponification of the oil may also occur by mixture with either lead or zinc. Again, some leads, notably those known as pulp leads, when mixed with oil into a paint will liver up over night. Where a pigment or lead has been burned in the grinding it will cause livering.

CONCERNING THE MODERN PAINT SHOP

THE ancient paint shop was located in a dark, damp cellar because this was the cheapest place the painter could find for the purpose. Of its faults we need not speak; they were and are too obvious. It served as storage room and mixing shop, office and reception room. The following description of a modern paint shop and business establishment combined is from the pen of a prominent master painter. The painter thinking of starting into the business of painting and decorating will find its perusal and study full of practical value.

"Many shops which can now be truthfully called modern were no better than their neighbors in the beginning, but have had proprietors who were alert and observing, and did not fail to apply to practical use any idea or suggestion that seemed worthy of adoption, and who were at the same time endeavoring to work out for themselves some of the problems of the day. And, while many a good man has been able to live for years and to raise his family honestly and well on the proceeds of a shop conducted in some dingy cellar or shed at the back of his residence, neither of these could be classed as modern paint shops by any stretch of the imagination, and neither they nor the business conducted in them are the kind contemplated in the writing of this paper.

"The modern painting and decorating business generally has its headquarters or office conveniently located. Its store room, stock room and workshop may be in a back street, or in some out-of-the-way place, but is then connected by telephone to the office, and thus is in direct touch with it; but it is even better to have office, store room and workshop under the one roof if possible.

"And further than that, the truly modern painting and decorating business will generally have in connection with its office a showroom for the exhibition of designs and other materials it is called upon to use from time to time; a laboratory for experimenting or testing materials; a workroom for the preparation of such materials as can be gotten ready before being sent out; a stockroom, with adequate shelving for the separation and ready supervision of the various articles in frequent use, a storage place for materials in bulk, and shelter of some kind for ladders, planks, and other tools; and last, but not least, a space wherein a separate locker can be maintained for every employee in the concern.

"The office of such a concern is conveniently located because, even with the telephone facilities made use of so extensively to-day, the head of it finds many customers coming to see him (if he is accessible) where otherwise he would be compelled to lose valuable time in calling upon clients who are perfectly willing to do the running, and even better pleased to visit his office, where explanations can be more readily made, samples of goods exhibited, more satisfactory conversations held and instructions given. Such an office generally includes a private compartment for the proprietor or manager, with suitable tables upon which sketches can be prepared or plans set out for convenience in estimating, and this compartment is so situated that its occupant can leave his work at a moment's notice and remain away for any reasonable length of time without any necessity for disturbing his unfinished work or feeling that others will be meddling with it during his absence.

"The showroom in connection with such an establishment is usually arranged with partitions or screens, so that several parties can be consulted at the same time without any danger of interference. This is a necessary as well as a profitable provision, as it is a hard proposition for a clerk in an establishment to interest one party in the selection of materials or a scheme of decoration for a small house or a few rooms, while in plain sight and hearing the proprietor is displaying designs and materials for decorating a mansion, and the contrast need not be, by any means, so great as to make the situation difficult and embarrassing for all concerned. There is, therefore, ample provision made for the separation of all clients who may chance to need attention at the same time.

"The laboratory, so called, may consist of only a part of the stockroom or storeroom partitioned off, but is provided with means to raise the temperature in winter, and to protect any experiment that is under way; and is also fitted with a table of some kind, a Bunsen burner, small shelves for materials, and a few tools that may be found necessary in testing materials or making experiments.

"The workroom is light enough to facilitate the mixing of colors when necessary, and is provided with scales, weights, and measures, shelving for materials in use, and is so located as to be easy of access for the expressman or carter.

"The storage space and tool shelter may be ever so rough, but it is sufficient to protect its contents from the elements, and, like the workroom, moderately accessible, to prevent any waste of time and energy in carrying materials or tools to and from the wagon. The lockers, which are large enough to hold a hat and coat, a pair or two of overalls, a brush pot and a few other tools, are provided with a lock safe enough to form some protection to its contents, and one that is not a duplicate of the others. There is also in the possession of the proprietor an extra key for each lock, or a master key, that will open any of them, as otherwise some of the men often find it necessary to return home before they can get at their tools.

"It may be impossible to figure these lockers as a great money-getter, but they help to inculcate neatness on the part of the employees, prevent unpleasantness or hard feeling over the mislaying or changing of brushes or tools, and in this way they make their cost seem insignificant. These lockers also enable each man to be sure that his belongings cannot be interfered with if set aside for a few days.

"To further promote neatness and prevent the smeary appearance so characteristic of the old-time shop, some special place is ofttimes prepared for wiping out of brushes, and for this purpose I could recommend no better plan than that illustrated in a copy of one of the trade magazines. It consisted of a shallow box, which could be nailed to the side of the building or wall, had several easily detachable boards on the back that could be removed when too thick with paint, and a door or cover on hinges, which could be kept closed to hide its unsightly interior.

"An establishment such as has been described, always supposing that it has the proper skill and experience at the back of it, and a proper complement of men—is ready at a moment's notice to carry out the wishes of a client in reference to almost any kind of contract, whether it be to finish the largest skyscraper, to renew the finest of hardwood, or to decorate an interior in the most artistic manner; and is even able and ready to select and procure its furniture and fittings."

SELECTING COLOR COMBINATIONS

It seldom occurs that the painter is asked to choose the colors that are to be applied to a structure, this being the privilege of the customer. Nevertheless the painter should know how to choose proper combinations for his own satisfaction and for use when a customer happens to ask his advice. The selection of the colors for a building is not an easy task in some cases, and always it is a matter of color science, the harmonious arrangement of colors being more than the mere exercise of the fancy or individual taste.

It is advised that the painter first learn the theory of color. There are but three distinct colors to begin with, namely, red, blue, and yellow. From these all the colors that he will ever use or find available will be obtained by mixture.

There are some rules governing the combining of colors for structural work that will be given here, and the painter should get them in his mind. Each building demands its own coloring, this being determined by its location, surroundings, etc. There are a few colors known as "safe," so called because they will be found to give satisfaction in most cases. These colors are mainly the reds, white, the grays, yellow and brown. For an irregular, nondescript house, a house really of ugly architecture, the grays and browns do very well; the gray should be on the yellow cast, rather than of a colder shade. For the country house white is standard, and this will apply to almost any formal type of house. The white house in the country shows up well in the distance, whether surrounded with its summer environment of trees and shrubbery, or in winter, amid bare limbed trees and leafless shrubbery. A low-lying, squatty house demands light and cheerful colors, and such will tend to increase the apparent height of the building. With the use of dark colors the effect would be just the opposite.

The Colonial style should not be painted with dark or pronounced colors, such as red, brown, etc. A pure white body nearly always answers, but in some forms of the Colonial a dark bottle green trim serves well with a white body. An old frame or old stone house will usually look attractive done with white body and nearly any shade for the trim, with green blinds. This green I think should usually be medium chrome, not the darker shade, nor the bronze or blue shade. Say it is a stone farm house, well situated; it will do with yellow body or white, with white trim and green blinds. Doors may be grained oak, or be white, both will look fine. Or the body of the house may be a brownish-gray, with white trim, with a dark chrome green for blinds, or a deep brownish-gray. It is almost a safe rule that any shade of color will do for the trim on a white bodied house, say, such colors as pea green, gray, light yellow, or a very light brown. A house painted with these colors will always present a neat perspective, and its architectural beauty is enhanced thereby. But if the white has been used until a change is desired, as will of course occur, for people will tire of the best in time, the body of the house may be painted a warm drab, or graystone, or medium drab, light bronze, or ivory white, with white or colored trim.

Color fads or fashions are seldom worthy of notice; good taste and simplicity, based on the laws of color harmony, being safe and surer to satisfy. A color scheme should be simple and fit the style of architecture and natural and artificial surroundings. The painted house should appear as a part of the landscape. We must take as factors trees and shrubbery or their absence, the distances from other houses, and the color schemes of other near-by houses. Also, as previously pointed out, the style of the house must be considered. Some houses must be painted white, trim and body, but this only in exceptional cases; as a general thing the house done entirely in white does not show up well, no matter how excellent its architecture. As a rule the white house will look better with some color to the trim, such as bottle green, light slate, medium drab, the drab produced with yellow ocher and black; a nice gray also will do. This will cause the white house to appear much whiter than when all white. And let it be remembered that when a house is painted white that the white should be really white, and not a white a little off-color. Some white lead will not give a true white, while some brands will; the addition of some zinc white to the last coat will make a fine white, and all zinc will give a still better white. But while the addition of a proportion of zinc white will do good rather than harm, all zinc white is apt to cause scaling or cracking, as it is a very hard, brittle metal paint. This is a pity, as zinc white has many merits as a paint, being non-poisonous and not affected by sulphur or other gases, which do affect white lead very much. Still, where the atmosphere is clear of such gases, as in the country and most suburban districts, white lead answers well. The sun and weather bleach out the oil and make a white job of it in time. And here it should be said that it is folly to paint a building white in the locality of factories or railroad engines, or to paint it even a light gray or other delicate tint or color. For such places we might suggest such combinations as light slate for the body, with light gray trim and black sash, roof olive. Or body medium drab, trim ivory white, and sash maroon. Such color schemes will do particularly well on city and suburban houses.

In this connection is given a list of useful color schemes. The colors given are arranged in the order—body, trim and sash.

No. 1—Pearl gray, pure white, maroon.
No. 2—Cream, light brown, dark bottle green.
No. 3—Ivory white, pure white, maroon.
No. 4—Pure white, dark bottle green, black.
No. 5—Medium drab, ivory white, maroon.
No. 6—Chocolate brown, pure white, white.
No. 7—French gray, pure white, maroon.
No. 8—Colonial yellow, pure white, white.
No. 9—Bronze gray, pure white, maroon.
No. 10—Fawn, pure white, maroon.
No. 11—Bedford stone, ivory white, chocolate brown.
No. 12—Slate, pure white, maroon.

Here is another table of harmonizing colors for house exteriors:

Colonial or Formal—Body white, yellow or gray; trim, white; roof, natural wood shingles or slates; blinds, moss green, bronze green or green.

Picturesque or Irregular—Body, red; trim, red with white sash; roof, natural shingles; blinds, very dark green. Or, body brown; trim, creamy white; roof, moss green, and blinds medium green.

Mansard Roof—Body, yellowish gray; trim the same; roof, usually slate; blinds, green.

Small Cottages—Body, red; trim, if not much of it, white; shingles, natural. Never use red if slate roof is blue. Blinds, dark green.

Upper and Lower Story is Different—Body, red below, gray above; trim in either case to be self-colored and sash white; roof natural shingles, and blinds dark green.

Cement and Stucco—Body, white, yellow or gray; trim, brown stain, for white and yellow, and white for gray; roof, in all three cases, red; blinds, for first two cases dark or bronze green, for gray body use a pale blue-green.

In suburban places it is well to select colors that will not duplicate others near by, no matter how beautiful and correct those may be, but select colors that will harmonize with surrounding color schemes, seeing that contrast of colors make a more interesting display under the circumstances.

Summer cottages are usually built for pleasure or pastime, or at best are temporary houses, hence should be given a light and bright coloring. The more solid and sober city house demands an opposite treatment, and if decked out in the coloring that would become the summer or suburban cottage would look quite ridiculous.

If more than one color is to go on the side of a house, see that the heavier or darker color is not placed above the lighter one. Dark coloring conveys the idea of weight and solidity or strength, and should not be held up by light colors, which have the aspect of being weak. This color rule holds good also in interior work, as will be mentioned in its proper place.

In brick and stone buildings the window frames should be painted the color of the capstones and window sills. For instance, a brick house, ornamented with limestone copings, should have the frames painted a light graystone color, with the sash black or dark green.

A city house on a small lot, near the street, should be painted a quiet color, with dark trim.

Quiet colors, pure white in particular, are growing more and more in the popular esteem.

In painting business or factory buildings, where there are heavy members carrying heavy loads, these should be done in the darkest colors used in the scheme, while those with the lightest loads to carry should be done in the lightest colors used, so as to appear more slender.

A light, airy structure will look stronger if a dark paint be used, unless the background is dark, when a light colored paint affords relief. With a small structure, in a large or deep landscape, more attention should be paid to the matter of contrast.

A good color scheme for the exterior of a handsome private stable is as follows: Paint the weatherboarding a dark drab, the stall blinds a dark drab, rain conductors a dark green, doors green with drab panels, sashes Indian or Tuscan red. If there are shingles on the sides, oil them, and the same if the sides are brick. Roof shingles dip and brush-coat red. Interior woodwork finish natural.

Here are a few practical color suggestions from a prominent architect:

A good combination shows a rich olive body with white trim. Roof moss-green. Side gable deep buff. Sash a greenish-black, and door deep green. Make the porch floor a green between the door and body color, the foundation a sandstone tint, and the chimneys a cream.

A low-posted cottage would be very attractive with the body white and the trim the same, the porch floor a mossy-green, or a burnt sienna, the roof stained olive green, with chimneys and foundation red. A good alternative scheme would be a copper-red roof and white body, giving a crisp and attractive effect.

A very attractive little house may be made by laying the lower story in chocolate color, and by painting the upper a lighter chocolate to harmonize with the brick; the trim should be white, the sash deep maroon, and porch floors and steps painted very deep and dull yellow. With the roof stained brown, and the brick chimneys to match the lower story, the result would be most pleasing.

A rather deep lemon yellow is suggested for the body of a simple house, white for the trim, a soft, harmonizing green for the gables, the sash in black, the roof moss-green, and the foundations and chimneys of red. This color scheme makes a good background for shade trees and shrubbery.

A house made for two families and the lot small requires a color scheme that will tend to make the building recede rather than stand out. A square form would suggest a modest color effect. A deep seal brown throughout, black sash, warm green roof, and red chimneys, porch floors and steps a very dull buff, ceiling of porch cream, will complete a very good color effect for this case.

An attractive color scheme shows a green shingled effect with white trim throughout, but in case siding must be used, lay the chimneys in cream brick. Stain the roof golden brown, paint gables and body tan, bordering on the chocolate, make the sash a deep brown, trim with a good white, paint the porch floors with Vandyke brown, medium shade, while the brick foundation should be painted to match the body.

The location of a square house should almost of necessity be known, in order to wisely plan its color scheme, for its form is so easily accentuated to the detriment of the design, whereas, it might be as easily, with a little thought, subdued and improved upon.

Assuming that the house occupies an ordinary level city lot, we will paint the lower story and trim a very deep, dark green; the upper story a deep, dull pumpkin shade, and the roof a moss-green. The chimneys and all the brick work should be red, and the sash painted greenish-black, while the porch floor should be olive green, and the ceiling cream color.

Painting Store Fronts

This matter was thought of sufficient importance by the Canadian Hardware Association as to justify its discussion at one of their annual conventions, and the conclusion they came to was, the black, or aluminum and natural finish or cherry, with the interior of the place cherry, or outside white and inside a dull red, was best, thus agreeing that the inside must be taken into consideration when determining the outside coloring. Some thought with cherry or bottle green outside, a natural finish would look best inside. White enamel for outside was also considered good. Indeed, a white outside with a dull red inside was very well thought of.

There are many suitable colors for shop fronts. As a rule they should be strong, decided tones, either very light, such as white, ivory white, cream, or biscuit colors, or very dark, such as bronze green, or other dark green tones. Deep Brunswick green supplies a good color, or shades of green made with Brunswick green and Prussian blue used alone or lightened with white. Dark peacock blue is a pleasing color. Weak tints or common shades should be avoided. Dark reds and leather colors supply a useful range. Common shades of green and red, all right in themselves, have become to much hackneyed for pleasing results. The painter should evolve shades which are out of the beaten track. Pure red makes a striking color, but it is not one which harmonizes well with display windows unless carefully managed. A little pure red, such as vermilion, introduced, say, round the window sash, is effective, with darker reds or warm toned colors. Aluminum powder may also be applied with good effect. Sometimes a shop front is the better for being treated simply and broadly, but if elaborate color treatment is desired, we know of nothing better than a scheme of contrasting shades, such as shades of chocolate, Quaker green and cinnamon, with lettering in gold, or cream, outlined. As to whether light or dark shades are most permanent: Light colors, as a rule, are. White and cream last well. All dark colors should be used flat and varnished. The aim at all times is to produce not only a striking front, but one which will harmonize with the goods displayed.

USEFUL INFORMATION

Definition of Color Terms.—*Color* is any one of the Primary, Secondary and Tertiary colors. *Hue* relates to a particular tone of color, as purple-blue, orange-yellow, etc. A *tint* is produced by adding a little color to white. A *shade* is obtained when you add black to a color. Grey and gray are the same, being different ways of spelling. But there are two kinds of gray, that produced by tinting white with a little blue, black and red, some add also a little yellow to warm it; the other gray is made by tinting white with a little black. A *hot color* is one that suggests warmth or fire, such as red; a *cold color* is the opposite and represents ice, blue standing for cold; a *warm color* is one suggesting sunshine, such as yellow.

Covering Capacity of White Lead Paint.—Properly thinned, an oil paint composed of white lead and oil will cover 1200 square feet of fairly smooth surface, per gallon. But there is no standard for this, as surface conditions vary so much.

To Assist Slow Drying Colors.—White lead is a good drier, and when added to a slow pigment assists it to dry. Burnt umber is a good drier, and, added to Vandyke brown, a slow drier, helps it, without altering the color. Raw sienna is a slow drier, and a little raw umber will help it. To assist blacks, all being poor driers, mix a little Prussian blue and red lead to produce a dark gray and add to the black. Or Prussian blue alone will do, and it helps, rather than alters, the dark black color.

Tests for Turpentine.—The mineral oils, such as benzine, gasoline, benzol, etc., are soluble in turpentine, but are not soluble in aniline oil. Mix 80 parts of turpentine with 20 parts of benzine and you will get a clear, uniform solution; place this in a small vial, add 100 parts of aniline oil and shake for a half-minute or so. Let it stand a minute, when there will appear two layers, distinct and separate. Explanation: Aniline oil mixes with the turpentine, but cannot mix with the mineral oil. The result is that the benzine is forced out of the turpentine mixture by the aniline oil, and must float by itself on the new mixture of aniline oil and turpentine.

Take, say, a vial 3 inches high, pour into it about one inch of aniline oil, and on top of this pour an equal amount of turpentine. Close the vial with your thumb, shake, and set aside. If after five minutes the mixture remains uniform then it contains no mineral oils. But if it is left standing a day or two, separation will sometimes occur, this being due to a change in the aniline oil.

Pigments Permanent and Fugitive.—Chrome yellow becomes dark in air containing sulphur. Prussian blue, cobalt blue, Antwerp blue and indigo blue will fade, singly or in combination. Chrome red, carmine lake and vermilion all fade under exterior exposure. Green made from Prussian blue and chrome yellow will fade under exposure to sunlight.

The stable colors are the umbers and siennas, burnt ocher and Vandyke brown. So also ultramarine blue. Of the reds the stable ones are Venetian red, Indian red, light red, and madder lake.

A Unique Mixing Rule.—For each gallon of oil used take as much pigment as four times the specific gravity of the pigment. Examples:

One gallon of raw linseed oil will require

26.40	lbs.	dry white lead.
12	lbs.	dry yellow ocher.
21.20	lbs.	dry zinc white.
20	lbs.	dry Indian red.
11.84	lbs.	dry umber.
10.40	lbs.	dry drop black.

Various Names for the White Pigments.—

Whiting. Bolted gilders', Spanish white, Paris white, English cliffstone, chalk, commercial whiting, calcium carbonate, carbonate of lime.

Gypsum. Terra alba, alabaster, alabastine, plaster of Paris, a natural sulphate of lime, hydrated calcium sulphate.

China Clay. Kaolin, white bole, hydrated aluminum silicate.

Zinc White. Zinc oxide, oxide of zinc.

Barytes. Heavy spar, barium sulphate.

Blanc Fixe. Permanent white, precipitated barium.

Silica. Silex, quartz, silicon dioxide.

Pigments That Contain Sulphur.—Vermilion (sulphide of mercury), cadmium yellow (sulphide of cadmium), ultramarine blue and sulphide zinc white.

How to Darken Colors.—To darken a green add blue or black; to lighten, add yellow or white. To darken blues, add Prussian blue or black; to lighten, add white. To darken vermilion, add Indian red or Venetian red, umber, or Vandyke brown, according to shade desired. To darken Indian red or Venetian red, add umber or Vandyke brown; to lighten, add vermilion. To darken umber or Vandyke brown, add black; to lighten, add Indian or Venetian red.

Oil Required for Grinding Colors.—To grind the following pigments to a paste in raw linseed oil in 100 lb. lots:

Burnt umber	93 lbs. oil
Raw umber	74½ lbs. oil
Burnt sienna	104 lbs. oil
Raw sienna	128½ lbs. oil

Pigments Not Affected by Sulphur.— Zinc white, barytes, silica, China clay, lithopone, terra alba, whiting, yellow ocher, Venetian red, Indian red, Tuscan red, ultramarine green, all the brown earth pigments, such as umber, Vandyke brown, iron oxide, etc., lampblack and drop black, ultramarine blue and Prussian blue.

Pigments Not Affected by Alkali.—Barytes and whiting, yellow ocher, Venetian and Indian red, cobalt blue, ultramarine green, siennas, Vandyke brown, iron oxides, ultramarine blue, and lampblack and drop black.

Pigments Lime-Proof.—Barytes, lithopone, zinc white, whiting, China clay, yellow ocher, Indian yellow, iron oxide reds, madder reds; and in less degree red lead and English vermilion, cobalt green and terra verte, umbers and Vandyke brown, lampblack and drop black, cobalt blue and ultramarine blue.

Are Any Pigments Permanent?—Strictly speaking, there are none, but the natural pigments come near the mark. Generally speaking, dark colors are more permanent and endowed with a larger capacity for service than the lighter ones, which in large part are made artificially or with a dye base. This does not imply that all chemically prepared colors worked out upon a dye base, or otherwise, are fugitive colors. It is well known that not a few of the most durable and finest pigments are in the chemically prepared class. Still, most of such colors are very brilliant in tone and beautiful in their surface effects.

Baking White Enamel on Iron.—White enamel is baked on galvanized iron at a heat of not over 180 deg. F. Use zinc white enamel and bake on several coats, mixing zinc white with baking varnish; bake each coat several hours.

Bath Tub Enamel Paint.—Break up 8 lbs. best French zinc white that has been ground in damar varnish, or other light colored varnish, and mix in slowly one-half pint of turpentine, after which add gradually while stirring 2 quarts of the best white enamel varnish—not damar. This will make 1 gal. of enamel varnish. Flake white ground in pale japan and thinned with turpentine will dry hard within an hour in light coats.

After Burning Off.—If, after burning off, you find the surface in poor condition, some parts spongy, others hard, glaze over with rough-stuff made from white lead, whiting, and japan; spread this on, as smoothly as you can, and after it is dry, say, in 24 hours, sandpaper it smooth.

Shellacking White Pine.—White pine, or any white wood that is to be painted white and requires a primer of white shellac, should have it on the bare wood, and not on the priming coat of paint.

To Keep Paint Good after Mixing.—After paint has been mixed and left to stand for some little time a skin will form over it; to avoid this cover it with water and on the water pour a little raw oil, which will prevent evaporation of the water, and both will prevent drying of the paint on top.

To Thin Coal Tar.—Thin with coal tar naphtha or, as otherwise known, light oil. Solvent coal tar or 90 per cent. benzol is also a good thinner, but it costs more. Heat the tar before thinning it.

To Clean Coal Tar Brush.—Clean it with the light oil mentioned in the foregoing item or benzol.

How to Thicken Paint with Soap.—Use a soap made from rosin and oil, finely shaved and melted in hot water. Don't use a tallow soap, as it would retard the drying of the paint.

To Paint on Leather.—Use colors ground in japan and thin with turpentine, with a little carriage finishing varnish as binder; don't use oil colors or oil paint.

Tinting Lead.— It sometimes happens that you have occasion to deepen the tone of a color a little and have none of the proper color with you; it is a good plan to always take along with you to a job some of each color that has been used in tinting the paints you are to use, thinned with a little turpentine and placed in a closed vessel, and then if needed it is on hand.

To Prevent Pine Knots from Showing.—Thin white shellac varnish is the standard knotting, but sometimes it does not hide the knot well. This may be due to the knotting being weak through age, the alcohol having weakened. There are many ways besides the shellac. Dry red lead, mixed with glue size, was once the favorite. Gold, silver, and aluminum leaf will effectually hide a knot. But a gold size must first be used, and when the leaf is put on this there is quite a raise in the surface at that place. To avoid this, sandpaper the place down well before size and leaf go on. Another formula: Mix ¼ pint of gold size, 1 teaspoonful of dry red lead, 1 pint of benzine, and 7 oz. orange shellac varnish. Shake once in a while. White or red lead mixed with gold size and applied warm is another stopping.

Why We Shellac Knots.—The reason is not well understood. It is necessary because knots are end-grain, lying at an angle to the main surface of the boards. A knot may cause trouble in several ways; the most important are, first, the great amount of suction; secondly, exudation of sap; thirdly, discoloration of the paint on account of sap of a pitchy nature present in all soft woods. Knotting stops suction and prevents discoloration. It cannot, however, always prevent exudation of gum. Nothing will do this completely, but it may modify the trouble after heat has been applied to the affected part in order to draw out the gum.

How to Paint Picket Fence.—We can lose a lot of time in doing this sort of work by not knowing how to do the work systematically. Take one panel at a time, clean it off, particularly the bottoms of pickets. Then paint the right side edges of the whole panel first, then return, and paint the left sides, finishing the rail between pickets, and lay off the fronts of rails last. After finishing a few panels this way go to the back of the pickets and do them and the rest in order. Better have a boy, or a man, on the back of the fence, while you carry along the front. That saves time, too. There is about twice as much work to do on the front as on the back of the fence.

Mixing Dry Red Lead and Dry Lampblack.—If you don't know how, it is difficult to mix these two pigments together. One way is to put the two together in a vessel that can be closed tight, and then shake it well for a few minutes; in this way the light and heavy pigments will become well mixed. The trouble arises from the fact that one is a very light and the other a very heavy pigment. After this mixing add the oil and work into a paste. Another way is to place the lampblack in a mixing vessel, add the oil to it, and mix it; then add the red lead and mix that in. Add the lead gradually and stir all the time.

To Clear Dirty Shellac Varnish.—Stir in a few crystals of oxalic acid and then allow the shellac to settle for a few hours. The liquid will become clear and the foreign matter will deposit on the bottom of the vessel; the clear liquid may then be poured off into a clean vessel, avoiding any metal vessel, which would stain the shellac. Add only a few crystals of the acid at a time until you notice the effect.

Paint Emulsifier.— Some emulsion liquids act badly on certain chemical pigments, but the following formula, devised by a German paint maker, is said to not affect the ordinary chemical colors in use. Dissolve three parts of silicate of potash in six parts of water; add 12 parts of raw linseed oil. The greater the proportion of silicate the stronger the solution. Then dissolve three parts of sugar of lead in nine parts of water and incorporate thoroughly with the oil solution. The proportion of lead solution must not be exceeded.

Why the Paint Did Not Gloss.— When you have an oil finish in hand remember that to get a full gloss the under coat must be more or less flat. It is the rule that a gloss upon a gloss makes a semi-flat finish.

To Paint over Calcimine.—Most of the water paints or calcimines on the market need no size before painting, but if a size should be thought best, then make the size from best white glue or gelatin. This will give a firm surface for the paint. Where a calcimine has had too little glue binder, it is necessary to size before coating over it with either water color or oil paint.

To Paint Window Shades.— Take some rather dry white lead, some that has become rather stiff with age, but yet not hard, and make it to a stiff paste with turpentine, mix in color you desire, then make quite thin with turpentine. If you have no old lead, better draw the oil from what you do have. Just enough oil to serve as binder, and driers sufficient. Stretch the shade on a frame, or against shop wall if this can be done, make the cloth clean, then apply the paint with a broad flat brush, getting on a thin coat; if it does not cover enough, you may add a second coat, though one coat usually does. The less paint the better. The paint is applied criss-cross, every way, which gives a more solid effect than laying it off. Machine-painted shades are recognized by the straight streaks of paint.

RELETTERING OLD STORE SHADE.—Paint the old shade as directed above, then follow the old lettering, which will show plain (unless new matter is to be lettered on), with oil size, if to be gilded, or paint-in.

VERNIS MARTIN FINISH.—This finish is used on both metal and wood. The surface must be made perfectly level and smooth. On this foundation, which may be made with paste filler or with iron filler or rough-stuff, according to whether the finish is to be on wood or metal, apply four coats of best gold bronze, mixed with banana liquid; use a soft hair brush, 1½ or 2½ inches wide and double-thick. The four coats are to be applied by brushing one way only. The first and second coats should dry in a warm room. Rub down each coat carefully with curled hair, being careful not to rub through the bronze. Apply quickly, and make long strokes, or you may rub up the under coating. To finish, apply one or two coats of good interior varnish, which should be rubbed or polished. Before varnishing the job apply a coat of thin shellac varnish. If picture or similar ornament is to be used, use decalcomania or paint by hand before varnishing. The method here given is that used by furniture makers. The method seems to be merely a glazing and varnish. To get the golden effect the furniture people give three coats, the priming coat being baked and hardened, with the second coat an extra good grade of varnish. The color is transparent, a rich golden tint, resembling the high-grade brass beds. All this may be done with paint, glaze, bronze and varnish.

Glue Varnish.—Take best white glue and dissolve in a quart of water. Use best brown glue to make dark varnish. When ready to use the glue varnish add 1½ oz. bichromate of potash, which will harden the glue and make it more or less water-proof. This glue will become insoluble if left standing long. Use it at once.

Why Oil Paint Dries Semi-Flat.—Paint drying flat is frequently, but not necessarily, an indication of adulterated oil. The best linseed oil paint will dry more or less flat where the surface is dry and porous, taking in the oil and leaving the dead lead. On such a surface the paint should contain much oil, to allow for sinking in. But if the paint has dried in, showing spotty, go over the priming coat with oil and touch up the lusterless or dead spots. Linseed oil that has been adulterated with mineral oil will give a paint that is sure to dry flat.

How to Make Flat Varnish.—Heat one gallon of the best hard oil finish, and in another vessel heat 6 oz. of the best beeswax; add these two together. Do this carefully. Stir in the wax slowly. Then add by careful stirring 2 oz. of raw linseed oil as binder and a help to the easy spreading of the varnish, that no laps or brush marks may appear. Mix the oil and 3 pints of turpentine together while the mass is hot. Strain through a fine strainer. Use only clean cans. Also clean brush.

Do a panel or other part at a time, for laps show and must be avoided. On exterior work use a good spar varnish. Careful work only will give you a good job. This is true of course regarding all work, but it is imperative in flatted varnish work.

A Water-Oil White Paint.—Mix together 40 lbs. of bolted gilders' whiting, 10 lbs. dry zinc white, 10 lbs. white lead in oil, 8 lbs. raw linseed oil, 6 lbs.

potash soap, and 26 lbs. soft water. It may be desirable to add also a quart of copal varnish. This formula will make about 100 lbs. of white paint, ready for the brush.

A Disinfectant Paint.—The addition of carbolic acid will give to paint disinfectant properties, but it will also discolor any but very dark paint. Boric acid and salicylic acid are useful for this purpose. Here is a formula for a white paint to which a disinfectant may be added: Dry white lead 20 lbs., best zinc white 300 lbs., raw linseed oil 4½ gals., white japan 3 gals. And any color desired may be incorporated.

Paint for Rough Work.—Take two parts iron oxide, dry, and one part whiting, mix to a paste with raw oil; add some cheap drier, and thin out with benzine and rosin oil. To make a better grade omit the benzine and rosin oil and use only the raw oil. But it will cost more. Dry ocher, the American grade, and Venetian red make good pigments for this purpose. Or cheap grade white lead and Paris white, colored with carbon black. Or ocher, whiting, lampblack, and blue, for a sort of olive green. A cheap black paint may be made upon this formula: Mix 18 lbs. boiled oil, 25 lbs. naphtha or gas black, 18 lbs. raw linseed oil, 112 lbs. barytes, and 56 lbs. of white lead.

Paint for Golf Balls.—One part of dry pulverized white shellac, 2 parts of denatured alcohol, and 1 part of lithopone, all by weight. Mix the shellac and lithopone together and put it in a bottle, then add the alcohol. Shake occasionally, until the shellac is dissolved.

Tiffany Finish.—This finish originated with the Tiffany firm of art dealers, etc., in New York, and was suggested by the light coming through stained windows and falling on the decorated walls. Naturally the effect would be a mingled display of the colors of the glass. To produce such a finish with paint there are several different ways, and the following is that used by a master painter of experience. He says that no matter what color the finish is to be, make the ground buff color, using white lead tinted with yellow ocher. On this ground apply a coat of white shellac, though this he says is not really necessary. The idea is to have a solid ground to glaze on. Use only the transparent colors, such as Prussian blue, the siennas and umbers. Glaze with one of the colors, and have ready small pots containing the several glaze colors, with a brush for each color. These colors are to be dappled on, making a mottled effect. After this mottling stipple it, to give a uniform surface. When this is dry apply a coat of pale copal varnish, for the mottling will not be uniformly flat or lustrous, but mottled, so that the shellac is necessary to produce a soft and semi-flat effect.

Flatting White Lead Paint with Water.—It is said that the addition of a little water to white lead will cause paint made from it to dry flat on walls and ceiling. First beat up the white lead in the keg, then gradually add the water and stir the lead constantly, and finally the water will mix mechanically with the lead. Then add drier and any desired color and reduce the mass to brushing consistency with turpentine.

Streaks in Dark Blue Paint.—Some blues of the rich dark shade are made up with a proportion of black in their composition, and the black, being very light, has a tendency to float to the surface when the blue is applied, and to cause streaks, which mar the appearance of the finished surface. To obviate this add a very little bluish-gray to the blue when it is to be used as a body color; the gray may be made with a little lead and black, with some of the blue to give it the requisite tone. It must however be sparingly used, or naturally it will change the hue of the whole color.

Imitating Red Slate.—The ground may be made with 3 parts of white lead and 2 parts of Indian red; mix with equal parts of raw oil and turpentine. And driers, as required. The graining or marbling is done over the foundation with Indian red and white lead. Underglaze with Indian red, make a pebbled effect, and vein in with a mixture of Indian red and white; when dry, coat with varnish.

Water Content of Paints.—Ordinary raw linseed oil carries usually from 0.50% to 1.50% or more of water. White pigments also carry more or less water; hence it is customary to allow a maximum of 2% of water as a natural content. Any amount over 3% of water may be regarded as pure adulteration. To test the presence of free water in paint, white paste or mixed, add a very little eosine (aniline pink) to the mixture, and rub it on a piece of porcelain or glass, then add a drop of water; as eosine red is unaffected by oil, turpentine or benzine, while easily dissolved in water, if any moisture be present it will at once show itself by the white paste turning pink.

Coloring Paint in the Pot.—When you wish to tint or color paint in the paint pot don't add the color direct but first break it up in some of the paint, in a cup, thinning it with a little turpentine or benzine, then adding it to the paint by degrees in the pot. Another good way is to beat up the lead to a stiff paste and then beat up the color with it.

Old Ivory Effect.—Make the proper foundation, then apply two coats of white shellac varnish, and when dry scumble with raw umber, rubbing it off in spots to produce the desired mottling.

Water-Proof Paint.—Shave fine 1 lb. of brown soap and dissolve in hot water 2 quarts. Then add and stir in 6 quarts of boiled oil and one ounce of bluestone. After removing the mass from the fire add 2 quarts of turpentine and color as desired. Strain well before using, and thin with turpentine to suitable consistency.

Non-Poisonous Paint for Toys.—Pulverized chalk 6 parts and calcined magnesia 3 parts; add a little ultramarine or soluble laundry blue to whiten the paint, and mix to paint consistency with white glue size.

Permanent Green Paint.—Articles exposed to the weather, such as lawn furniture, etc., and which are to be painted green, need a green that is as permanent as possible. Medium chrome green does fairly well, and emerald green is still better. It is more permanent than any other of the green class, and less affected by sulphur and impure air.

Fireproofing Shingles.—Any good oil paint will make a good fire resistant on a shingle roof. The danger from a fire brand or spark on a dry shingle roof consists in the fact that the shingle is like tinder when dry, but when it is coated with paint the spark cannot get at the wood, but expires on the painted surface. Use any good mineral paint, such as iron oxide, for instance.

Repainting Yellowed White Work.—Where a room was painted white years ago and is now quite dark of color, it will be useless to paint over it with the expectation of getting a white job. The way to do is to shellac over it, with white shellac, and paint white on this surface. This will sometimes fail, but it is the best way we know of. As a general thing such work cannot be made white again without removing the old paint.

Turpentine in Exterior Paint.—Some painters use a little turpentine in all outside paint, and its use is debatable. If the oil is somewhat old and fatty a little turpentine will help, in the proportion of one part turpentine to eight parts of oil. Turpentine tends to harden paint, makes it work easier, but is thought to impair the durability of the last coat.

Another Dope Paint Formula.—Take 150 lbs. of gilders' whiting and mix to a paste with water; then add 6 gals. of hot soft soap; then break up 60 lbs. of white lead in 3 gals. of boiled oil, and when mixed to a paste add 3 gals. more of oil, then stir the lead and whiting mixtures together. Then the mass should be run through a hand mill, something that should be in every paint shop.

Imitation Gold Color.—Take flake white ground in varnish, tint it with lemon chrome yellow and a touch of vermilion. Gold paint color may also be bought ready prepared, in tubes.

Painting over Creosote Stain.—If there is anything that will prevent the stain from coming through it is shellac, and this may fail in some cases. Let the shellac dry perfectly hard before you apply the paint over it.

Evaporation Points of Spirits.—The rate of evaporation of wood alcohol is twice that of grain alcohol. The rate of evaporation of acetone is twice that of wood alcohol. Grain alcohol at a temperature of 104 degrees Fahr. is just equal in point of rapidity of evaporation to that of turpentine at the boiling point of water.

To Prevent Red from Striking Through.—A master painter says that a coat of shellac will prevent bleeding red from showing through paint. In applying red, either bleeding or non-bleeding, it is safest to give the work a coat of ground color, composed of 3 parts Venetian red and 2 parts zinc white. In the case of a varnish finish of course the ground color must be made flat, and the finishing color should be ground in japan.

Green Slating Paint.—For black-board. The surface must first be made smooth and even. Then apply two coats of this paint: Mix together 1 lb. each of Prussian blue and medium orange chrome yellow. Thin with equal parts of oil size and alcohol to the consistency of thin cream. Apply with a wide stiff bristle brush. After 24 hours smooth off with felt, then give it a second coat of the slating paint. The shade may be altered by varying the proportions of the two colors.

A Cheap Slating Paint.—Take lampblack in oil 4 lbs., ultramarine blue in oil 1 lb., and pulverized pumicestone 1 lb. Mix, thin with turpentine and add a little driers. Another formula: Mix up some japan drop black in varnish and add enough powdered rottenstone to make the paint flat, then thin up with turpentine.

Another formula: Slow drying. Take 1 lb. of drop black in oil, ¼ lb. ultramarine blue in oil, and 1 lb. fine emery flour, mix to a paste. Then add ½ gal. coach japan and stir to a paste, then add 1 pint of turpentine, mix all together, strain, and it is ready for use. In place of the emery flour use fine pumicestone flour.

Touch-Up Jobs.—When touching up an old straw-color job make the color as near the original as possible, then mix in a few drops of asphaltum, which will impart the dirty or stained appearance of the old paint. An old vermilion job may be touched up with vermilion stained with a little Venetian red. Asphaltum will give a dirty look to white, cream, pearl or silver gray, buff, and any color containing white.

Pigments Permanent to Light.—All the whites, all of the blacks except black lake, yellow ocher, medium and orange chrome yellow, Venetian red, iron oxides, American vermilion, chromium oxide green, terra alba, lime green, zinc green, raw sienna, raw umber, cobalt blue and ultramarine blue.

PIGMENTS SAFE TO USE WITH LIME.—Unaffected by lime or alkali in any pigment form. These are silica and similar inert whites, zinc white, yellow ocher, Venetian red, iron oxides, Indian red, English vermilion, chromium oxide, lime green, terra verte, ultramarine green, raw umber, burnt umber, raw and burnt sienna, cobalt and ultramarine blue, lamp and carbon black. The regular lime-proof mortar colors are zinc white, yellow ocher, Venetian red, lime green, iron oxide or mineral paint, and lampblack.

PIGMENTS AFFECTED BY LIME OR ALKALI.—White lead and all pigments made on a lead base, such as chrome yellows, or containing any lead in their composition, such as Prussian blue, vermilion, emerald green, cadmium, rose pink, the lakes, and most vegetable colors, such as madder, etc., are affected.

MIXING THE PRIMING COAT.—The proportion of oil to the 100 lbs. of white lead for priming purposes on wood varies with painters, some allowing 5 gals., others up to 7 gals. Some add as much as ½ gal. of turpentine, in which case that much oil is deducted. Much depends upon conditions, season of year, weather, variety of wood, etc. In cold and damp weather turpentine is useful, also more driers need to be used. In summer weather driers should be used very sparingly, as they tend to prevent the oil from sinking into the wood as it otherwise would, by setting the oil too soon. Some painters use some zinc white with the white lead priming, though just why we do not know. Perhaps they think it gives a harder surface. When zinc white is added more driers are required, as zinc is a very bad drier. It is best to use freshly mixed paint for priming, and bad to use boiled oil.

FORMULA FOR MIXING POT OF PAINT.—To mix a pot of inside white paint take 8 lbs. white lead, in oil, best grade white zinc, in oil, 8 lbs., thin out with turpentine and add driers; pale japan is best. Strain the paint. This will give, after straining, about 10 lbs. of mixed paint, or an ordinary pot of paint. The proportion of turpentine and japan driers should be 13 oz. and 2 oz. respectively.

REPAIRING CRACKED WALL.—Plaster of Paris and glue size make a good stopping, but is apt to crack some. Sandpaper it smooth and then give it a coat of shellac. A hard putty is better, made from white lead and whiting, with a little varnish and japan drier. Large cracks must be keyed or cut out so that the inner part is larger than the outer, so that when filled the putty will hold. As plaster filling will shrink some it will need to have two coats; when dry, sandpaper smooth, then a coat of shellac. For an old wall or ceiling, where one part is higher than the other, along the crack, employ the French method: Mix white lead and coach japan to a stiff paste and apply it with a broad glazing knife. Level it so that the low side will be raised to a level with the high side. Sandpaper smooth.

HOW MUCH DRIERS?—No arbitrary rule can be laid down as to the amount of driers to use in mixing paint; it must be left to the man who undertakes to mix the paint, and he will be governed by circumstances. Driers differ in strength, pigments differ in their drying qualities, and then the weather, time of year, location of work, etc., all are factors that have to be reckoned with. With long practice the painter learns to know just how much driers is needed in any particular case, though he is likely to use too much rather than too little. Driers injure, while they help, the paint, burning the oil by oxidation.

Is Kerosene Useful in Ordinary Paint?—Coal oil or kerosene is a non-drying oil, it has no adhesive qualities, it is not oxidized or changed, nor will it combine with other materials under ordinary circumstances. It is therefore useless in paint, deleterious when mixed with linseed oil, as it retards and even prevents the drying of paint.

How to Paint Hemlock.—This is a difficult wood to paint. The priming should be applied with a full brush, and the paint should be rubbed in well. Don't use too much driers, and give the coat plenty of time to dry. The first two coats should be thin, and while a third coat will make a finish, four coats would be better.

A Good Glue Size.—Soak 2 lbs. of fish glue in ½ gal. of cold water. Dissolve 8 oz. pulverized alum in ½ gal. water. Pour the water off the glue and dilute the glue as desired. Then add the alum water. Melt 1 oz. white soap in boiling water and add to the solution, to give it elasticity.

Paint for Exterior Work.—It may not occur to the average painter that a four-square building, that is to say, one with its four sides exposed to the weather, will require different paint for each side; for instance, the south side being most exposed to the sun will require more oil in proportion to the lead used than will be needed on the north side. So with the east side, which receives hard wear from easterly storms, and will require a heavier and harder paint than the other sides, while the west side will need plenty of oil and a rather stout paint, because it has both a hot sun and south-west storms. Thus it will be seen that a paint that may be right for one side may not be right for another side. In fact, when painting a frame structure of this sort due regard should be had for the requirements of the different parts of the work, both in relation to the weather and the material.

Is Boiled Oil or Raw Oil Best?—Raw oil is more porous than boiled oil, allowing the air to pass through it more rapidly; it dries from the bottom up, or from the inside, and it takes longer to dry away from dust, etc. Boiled oil dries from the top down and through, so that in a short time it has a skin formed over it, which is, so-called, air-tight. It dries quicker than raw oil, but, owing to its exclusion of the air, takes longer to reach the resinous state, and on that account is said to be more durable than raw oil, or better weather-resisting. Real kettle-boiled oil is what we have in mind when saying this.

Removing Yellow Cast from White Paint.—White lead paint mixed for interior work, and containing some linseed oil, will become yellow or brownish-yellow in time. When mixed with turpentine only this yellowing does not occur to any perceptible degree, though it contains the oil that the white lead was ground in. To give the lead paint a whiter look it is customary to add a little blue, just as the laundress puts a little soluble laundry blue in the rinse water, to give the white clothes a better appearance. If you do use blue to whiten the paint remember that ultramarine blue gives a rather greenish cast. If you choose the ultramarine blue for the purpose then take one that has a violet hue, rather than the one with the greenish hue. True lampblack would probably be better than the blue, but it must be made from oil, as the gas carbon black will not do. Drop black tends to increase, rather than diminish the off-color effect of white paint.

Preparing a Front Door for Graining.—The front door was badly blistered. The old paint was then burned off, to begin with, the rosin in the white pine wood was burned or drawn out with heat, then shellacked. Then the door was primed with red lead thinned with 2 parts boiled oil and 1 part turpentine. When dry it was sandpapered and puttied with a mixture of dry white and red lead, equal parts, and a little whiting, and japan gold size. When hard-dry, the paint was sandpapered smooth and another coat of red and white lead was applied; after this two coats for the graining ground were applied, containing no red lead. The first of these two coats was mixed with rather more boiled oil than turpentine, but the gold size was used in both. The door was then grained and varnished with good carriage varnish. At the end of two years there was no evidence of blistering.

Why Paint and Oil Become Fatty.—This condition is due to the elimination of glycerine from the oil used as a binder to the pigment, which renders the compound fatty or greasy, unless the pigments are such as will absorb the oxygen, such as red lead and red oxide of iron.—*Standage.*

To Mix Water with Mixed Paint.—In white lead paint water may be added without the use of chemicals by adding a very little at a time and stirring it well. For other paints, in which a larger percentage of water is to be incorporated, use this formula: 1 lb. sal soda, 1 lb. of borax, dissolved separately in 5 gals. of boiling water; mix, then add, while stirring, 2 gals. raw linseed oil. Let it stand three days, then stir again and add a gallon of the mixture to every 10 gals. of mixed paint, if the paint is composed of lead. For paint composed of mineral or iron oxide add only a gallon of the mixture to 15 gals. of the mixed paint. More than this will give a much poorer paint. This formula holds up the paint and does not allow it to become fatty. The ultimate effect is to make the paint porous and less weather-resisting, the water evaporating.

To Bleach Dark Spots in Wood.—Knots and other dark parts in natural wood may be made paler by the use of chloride of lime, 17½ oz., and soda crystals, 2 oz. Dissolve in 10½ pints of water, after which apply a solution of sulphurous (not sulphuric) acid. Pine knots cannot be bleached.

Paint Spotted and Bleached.—An oil-painted surface in time loses its gloss in spots, and the cause is the driers. Litharge and sugar of lead driers both tend to make the paint spotty. Oil that was not properly tank-settled is another cause.

Thinning Thick Boiled Oil.—Boiled oil that has become too thick may be thinned by stirring in turpentine or deodorized benzine until it is sufficiently fluid. If this does not answer, or not make it work freely, add some raw oil.

Working Up Old Paint Skins.—Boil them with some raw linseed oil. Then take from fire, add some benzol, just a little, then thin out with benzine, enough to let the paint pass through a strainer. When this paint becomes cold it will be thicker, then it will have to be reduced some more. Another way is to cut the stuff with sal soda dissolved in water, forming an emulsion paint, which is not quite as good as the other paint. To 1 gal. of water add 1 lb. of sal soda, cover the skins with this, and let it stand for a few days. Then pour off the water from the top of the stuff and thin up with oil or benzine, or with both.

Quick Lead Paint.—To get a rapid drying white lead paint, for a particular purpose, grind white lead in alcohol and thin with white shellac.

To Paint over Burlap.—When the burlap wall material fades it can be painted. Fasten any loose parts with paste to the wall; apply varnish size, then paint it any desired color. Either gloss or flat finish may be made. Or the last coat of paint may be glazed with any transparent color; apply it thin and rub out to scumble it.

TREATMENT FOR MILDEWED BURLAP.—Brush off with a stiff brush and apply this size: Dissolve 4 oz. alum in 1 gal. hot water; 4 oz. bluestone in 1 pint of water; 2 oz. best white glue in 2 quarts of hot water; and 2 oz. sugar of lead in 1 quart of water. Mix separately and while hot; add the bluestone solution last. Allow it to dry.

HOW TO PAINT WINDOW BLINDS.—Don't hold it by the edge when painting inside of the rail, as that will cause the paint to run into the pin-holes of the slats, causing the slats to work hard when the paint dries. When the blind is done set it on strips on the ground or floor, with the top part down, so that should any dirt get on that part it will not show, or if the paint there is marred it will not show. Also, by thus setting the blind should any paint run it will not go to the bottom part, and cause hard drops of paint to catch on the window sill. Open out slats when they are done; have a little stick for opening and closing the slats, saving fingers from paint. Leave hand-holds on each side of the blind and shutter, and after setting it up paint those parts. Have a rag for wiping hands on, and try to keep hands free from paint.

CLEANING ENAMEL PAINTED SURFACE.—Dust off clean, and then cleanse with the following: Have a damp cloth and some precipitated chalk and with these give the work a gentle rubbing. Soft flannel is best, and Paris whiting will do in place of chalk, though there is less danger from scratching with the fine chalk. Dip flannel rag in hot water and wring out dry as possible, then dip it into the whiting. Then wash off with clear water, and rub dry with soft chamois or flannel rag.

To Clean Dirty Paint.—Good for dirty walls in particular. Slice 1 lb. of good brown soap in 3 quarts of hot water; add 1 oz. borax powder; let simmer on stove, do not boil. Stir occasionally. Use an old flannel for rubbing surface with this cleanser. Wash off with clean water as you clean the dirty surface.

To Clean Slate Blackboard.—To remove oil, grease, dirt, etc., from slate blackboard use paint remover, or benzol, or alcohol, and should these fail try equal parts of banana oil, carbon bisulphide and fusel oil, mixed and applied with a sponge. Strong ammonia may answer the purpose.

A Dipping Paint for Window Sash.—For cheap paint for dipping sash in, as practiced at factory, mix together 8 gals. gloss oil, 1 gal. raw linseed oil, and 1 gal. pale japan drier. With this mix 25 lbs. of bolted gilders' whiting, then strain. Thin up with 2 gals. benzine.

Cleaning Painty Overalls.—When overalls are not changed and washed weekly, but are worn for a long time without cleaning, it is hard to remove paint and restore whiteness. My own method is to soak the overalls in a bucket of warm water, in which place a half pound or more of sal soda. Let them be in this for two days, in which time the hard paint will have become softened. Take out and lay on a board or table and scrub with a hand scrub, with plenty of clear water and brown soap. After this has been done thoroughly rinse out in several clear waters, and hang up to dry. Dark paint spots may be taken out with chloride of lime.

How to Make Gloss Varnish.—Boil 1 gal. of raw linseed oil for an hour, then stir in 2 lbs. of pulverized rosin, stirring until the rosin is melted; then ½ pint of turpentine and an ounce of gum camphor; strain it.

Primer for Hard Pine.—In 1900 an experiment was made in which a square, 100 feet, of Georgia pine was nailed up on a southern exposure and primed with a mixture of pine tar 1 part, boiled linseed oil 3 parts, and no pigment. When perfectly dry two coats of white lead paint, thinned with boiled oil, were applied. Examined after three summers had passed the work was found in good condition, no checking, cracking, or chalking.

Cleaning Paint Pots.—Saw a barrel in two and use one of the halves for a lye barrel. Put 5 lbs. of fresh stone lime in it, and water enough to slake the lime. Then add 2 lbs. concentrated lye and water to make 15 gallons. Stir until the lye has dissolved, then it is ready for the dirty paint pots. Another way: Put some shavings, paper, or excelsior in the pot and pour on a little coal oil; set fire to the stuff, and in a few minutes begin scraping down the insides, which will add to the intensity of the fire and keep it going; then scrape down the outsides. In a few minutes dump out the fire and finish scraping inside and out.

Glue Size for Old Exterior Work.—"I painted a building, two sides of which was new siding, the other two sides old wood and rough. The new work got two coats of lead and oil paint; the old work was sized with glue-and-whiting, and finished with a coat of lead and oil. Glue size was very thin and only enough whiting to make a thin paint. Applied glue size with whitewash brush. Applied hot. After 20 years the old work looks better than the new work. The old wood must be quite dry before sizing."

To Make a Drying Oil for Zinc Paint.—To make boiled oil especially adapted for zinc white paints, or indeed for any paints, mix one part of binoxide of manganese in coarse powder, but not dusty, with ten parts of raw linseed oil; keep it heated and frequently stirred for 30 hours, or until the oil begins to turn reddish.

Fire-Proof Paint.—Mix the liquid as follows; use any desired pigment with it. To 1 gal. of a mixture of equal parts of lime water and vinegar, add 8 oz. table salt and 4 oz. sulphate of zinc, each powdered. Boil the mixture, then add 1 gal. of boiled oil and repeat the boiling. Take from fire and stir in 1 gal. of crude petroleum oil, heat again carefully now on account of fire, bring to the boiling point and it is done.

Soda-Glue Solution.—This is sometimes used in making cheap ready-mixed paints. Water 200 gals., sal soda 5 lbs., borax 1 lb., glue 2 lbs. Mixes with any pigment to form a paint.

Borax Solution.— Take 10 parts of borax, 30 parts of coarsely pulverized shellac, and 200 parts of water; dissolve by steam bath for a few hours, and when cold filter; a few drops of glycerine will make it more pliable or elastic.

Compound Lead-Zinc-Whiting Paint.—Mix together 50 lbs. white lead ground in oil, 25 lbs. zinc white and 25 lbs. Paris white or gilders' best bolted whiting, both dry. First mix the lead by itself, then mix together the zinc and whiting by sifting the two, and mixing with oil; then mix this and the lead together; run through strainer.

Grain Paint.—This is the name for a cheap surfacing paint, for old weather-beaten work, etc. Boil 2 lbs. rye flour and while boiling add 2 lbs. of thinned old paint, stirring the mass until perfectly mixed. Apply two coats.

Surfacing Cracked Paint.—To save burning off the cracked paint fill the fissures with a paste made as follows: Dissolve 2 oz. good glue in water, and stir in it 1 lb. whiting and 2 oz. dry white lead. Make a paste thin enough to brush on, and, while the brush usually answers, you may use a putty or glazing knife also. When it has dried hard rub down smooth with sandpaper, apply three coats of paint, and you will have a smooth job.

REMOVE LOCKS, ETC., BEFORE PAINTING DOOR.—All hardware should be removed before repainting a door, and the same rule will apply to sash fasteners, etc. This will save time and make a nicer job than cutting around these things.

LIMEWATER FOR PAINT.—To make a limewater emulsion paint, slake ½ bu. fresh stone lime in 40 gals. hot water, and let it stand 24 hours, then draw off the clear water for use. This lime water is to be added to raw linseed oil enough to change the condition of the oil; just how much must be left to judgment. Then stir in whatever pigment you wish to make the paint with.

ANOTHER FORMULA FOR MAKING EMULSION SOLUTION.—This formula is one that was used by a manufacturer of ready mixed paints. So it should be good!

Lime water	3 parts
Lead and zinc solution............	1½ parts
Sodium silicate solution...........	1½ parts
Benzine	5 parts
Raw linseed oil...................	3 parts

The lead and zinc solution is made with 2 parts of sugar of lead (lead acetate) and 4 parts of zinc sulphate, dissolved in 16 parts of water. The silicate solution is made by dissolving 1 lb. of silicate of soda (water glass) in 1 gal. of warm water.

A MILK PAINT.—Into 1 gal. of whole milk stir about 3 lbs. Portland cement, and any dry color you may choose. Sour, skim, or buttermilk will do, but the whole milk is best. Keep paint stirred all the time you are using it, it settles so. Said to wear well and last for years on barns, fences, etc.

Flat Oil-Water Paint.— Place 50 lbs. gilders' whiting in a tub and cover it with water; let stand over night, then pour off surplus water and beat up the mass with 2 gals. hard oil or gloss oil, or any cheap varnish, thinning it a little, then add any desired coloring. Then thin it down with benzine or turpentine, the former cheapest, until of proper brushing consistency. Dries flat.

How to Thin Oil Paint with Water.—Place 1 lb. of bleached shellac gum and ½ lb. sal soda in a porcelain vessel and cover with water; place on stove and bring to a boil, continuing until the gum and soda have dissolved. When cool it may be put in bottles. To use, add at rate of ½ pint to 1 qt. of paint. Stir it in, and after the paint has become thick add water to bring it to a brushing consistency.

To Make Drying Oil.—To ½ gal. water add 1 lb. sugar of lead; shake occasionally, and when the lead is dissolved add 2 qts. water, then filter the solution and add 3 gals. raw linseed oil. Stir into it 1 lb. powdered litharge; shake often, then let it stand several days. The oil found on top of this will be the drying oil; it must be poured off into another vessel. This liquid is clear and bright and dries in about 24 hours.

Some Cheap Paint Formulas.—Take two parts Venetian red and one part gilders' whiting; mix to a paste with raw oil and thin out with benzine one part and raw oil three parts, and 1/7 as much of rosin oil as of the other liquids combined. Mix 1 lb. each bicarbonate of soda and phosphate of soda dissolved in hot water and stirred into the paint.

Glue Sizing Hard Finish Wall.—How should glue size be used under paint so the paint won't peel off? First apply a coat of flat wall paint, and when this is dry give it a thin coat of glue-and-alum size. Finish with a coat of flat oil paint. The paint won't peel off.

To Hasten the Drying of Oil Paint.—If you use too much driers, it will soften the paint. It will also retard the drying. Try adding one-fourth as much water glass as you have of paint.

To Soften Hard White Lead.—Dig it out of the container and place it in a vessel, over it pour hot water. In a few hours the lead will be soft enough to work in oil, and it should be mixed at once, as it goes hard again if left to get cold.

Flat Oil-Turpentine Paint.—Use white lead or zinc white, or the two together, and add color or leave it white, and thin out with turpentine. This is simply a dull, not a flat paint, owing to its oil content. The addition of a little good hard-drying varnish will improve it, and make it washable.

Emulsion Paint Solution.—This emulsion liquid may be used with any base, white lead or inferior white base pigment.

Concentrated lye, potash	1 lb.
Dissolved in water	1 gal.
Fresh slaked lime	2 lbs.
Slaked in water	4 gals.
Good glue	1 lb.
Dissolved in water	1 gal.
Zinc sulphate	2 lbs.
Dissolved in water	3 gals.
Whiting	100 lbs.

Prepare the four solutions in separate vessels. Add the lye to the limewater, pour in the glue solution, and finally add the zinc solution. Add water to make 20 gals. and stir in the whiting.

Painting over Coal Tar.—Scrape off all you can of the tar, then apply a thin coat of brown shellac varnish.

PAINTING STUCCO DECORATIONS.— First brush off the work and make it clean. Prime with equal parts of white lead, red lead and boiled oil, by weight. The second coat, white lead with driers; color if desired. Thin this coat with two parts boiled oil and one part turpentine. Third coat the same, and if a fourth coat is desired, use no turpentine in it.

PAINTING CANVAS FOR ROOF OR FLOOR.—Say it is an 8 oz. canvas, stretch it and tack it with galvanized tacks. After painting the under side and allowing it to dry wet the upper side with water, then paint it while it is damp. It is found that this method makes the canvas water-proof.

WHY IRON OXIDE PAINT LOSES LUSTER.— This often occurs with iron oxide paint when mixed with raw oil, and more especially when some turpentine has been added. Thin with boiled oil, adding a little good spar varnish or japan gold size.

PAINTING HORSE STABLES.—Ordinary house paint will do, but avoid any pigment that is affected by ammonia and sulphur. White lead will not do.

REPAINTING SANDED WORK.—If the old sand is in good condition you can paint over it and sand it. But if not in good condition then remove all the old sand and resand it. Scrape off the old sand, as it cannot easily be burned off. Before scraping, wet the surface with benzol or paint remover to soften it.

WHEN IS THE BEST SEASON FOR EXTERIOR PAINTING?—Opinions differ, but most of the standard authorities agree that a temperature of from 55 deg. to 80 deg. Fahr., with an atmosphere that is as free from moisture as possible, gives the best results.

PAINT FOR WIRE SCREEN.— Take drop black, ground in oil, and about a third as much asphaltum varnish as black, and thin with turpentine; add a little driers; strain.

Paint for Structural Work.—A paint that was used on the elevated roads of New York was made as follows: Finely ground red oxide of iron 7½ parts, boiled linseed oil 9 parts, turpentine 1 part.

Varnish in Outside Paint.—A little spar varnish of good quality in the paint for the outside of a building will tend to toughen the paint and give it a fine, lustrous appearance, but as a general thing it is not advised.

Painting in Frosty Weather.—A little turpentine added to the oil paint used in winter on the outside will tend to prevent wrinkling and cause the paint to spread easier. But do not use too much, as it will injure the gloss.

When Is Paint Dry?—In other words, how long a time should intervene between one coat and the next? In a general way we would say 24 hours, but circumstances must be considered. One painter says he allows ten days, or even more, according to the weather. But this is too long. As a rule 24 hours is enough. In theory it is better to not allow too much time between coats, for when the paint is still fresh and elastic it will absorb some of the oil of the succeeding coat and thus give it an anchorage, the two coats amalgamating.

Insoluble White Shellac Gum.—When shellac gum has been over-treated with chlorine it is apt to be insoluble in alcohol, but if it is first moistened with 1/20 of its weight of ether and allowed to swell in a closed vessel its solubility is restored.

What Is Prepared Rosin?—It is a synthetic rosin. An artificial rosin. There are several grades of rosin, as used by makers of varnish, one called water-white rosin, which is the highest priced one, and is used in making shellac substitutes.

A New Paint and Varnish Remover.—This is a wire brush woven upon a strip of heavy canvas, the teeth set at an angle which engages whatever has to be removed. This strip is secured by a screw between two wooden blocks and can be replaced in a moment. It is said to have durability and may be worn down to the face of the canvas. It is claimed to remove paint or varnish from floors and other places quicker than any other tool for the purpose on the market. The tool sells for less than one dollar.

A Shop Paint Mixer.—This machine has been on the market several years, and is a perfectly satisfactory machine for the purpose; there are sizes adapted for large and small batches of paint. They will repay their cost in no time, saving time and labor.

Clear Varnish for Enamel Paint.—Add 2 qts. of strong denatured grain alcohol to 4 gals. of damar varnish and shake well. While the resultant varnish will look dark it will not affect the finish at all; the purpose of the alcohol is to remove the opalescence of the damar varnish, and you get a clear, transparent liquid, which also makes the varnish dry harder. Another clear varnish may be made by dissolving a pound of gum sandarach and 4 oz. of clear Venice turpentine in 4 oz. of 94% alcohol in a hot water bath, with gentle heat. When the gum is dissolved and while still warm filter through fine muslin.

To Bronze Ironwork.—To a pint of alcohol add 4 oz. gum shellac and ½ oz. benzoin; set in warm place and agitate once in a while. After the gums have dissolved allow the mass to settle two days in a cool place. Then pour off the clear part into another bottle, which keep well corked. To what was left in the first bottle add enough alcohol to make it work easy, strain through a fine cloth, and use as a primer. Now take ½ lb. finely ground bronze, thin it with varnish, and add coloring matter. If possible, warm the iron a little, and apply the bronze with a soft brush; repeat if necessary. A coat of varnish will protect the bronze. The color of the bronze may be varied with lampblack, ocher, etc. Parts in relief may be done with bronze of any desired color. Coat until you have a uniform and solid surface; protect with varnish.

Painting Steel Water Tank.— Red lead paint should be used on first coat, and there is no better paint for the succeeding coats. The exterior may be done with any carbon paint, say, graphite.

Paint for Structural Ironwork.— A railway paint chemist gives the following formula: French yellow ocher 39 lbs., lampblack 1 lb., raw linseed oil 54 lbs., japan drier 6 lbs.